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ART. XXXII.—*Observations of the Transit of Venus, Dec.* 6, 1882, *at Princeton, N. J., and South Hadley, Mass.* (Communicated by Professor C. A. YOUNG.)

I. STATIONS.

THE observations of the Transit of Venus in Princeton were made at three different points: at the observatory of the John C. Green School of Science, at the Halsted Observatory, and at the private observatory of Dr. S. Alexander.

The *astronomical* latitude and longitude of the first-named station are, respectively, 40° 20′ 57″·8, and $9^m\ 34^s{\cdot}54$ east of Washington. Its *geodetic* lat. and long. are 40° 20′ 54″·0, and 74° 39′ 16″·9 west of Greenwich, determined by reference to a neighboring Coast Survey station, and using Clark's spheroid. The Halsted Observatory is 1″·98 south and 29″·06 west of the S. S. Observatory, and Dr. Alexander's station was about 400 feet northeast of the Halsted Observatory.

The observatory at South Hadley is in latitude 42° 15′ 18″·2, and its approximate longitude is $18^m\ 05^s{\cdot}0$ east from Washington.

II. TIME.

The time used at Princeton was that of the standard sidereal clock of the S. S. Observatory. The beats of this clock are communicated electrically to every room in the building, and to the Halsted Observatory, and were used directly by all the observers, except Dr. Alexander. The error of the standard

clock was determined by Mr. McNeill with the Transit instrument on the evenings of both Dec. 5th and Dec. 6th. We also received the Washington noon signals on the 5th and 6th; and after correcting them for the errors of the Washington clock (obligingly communicated to me by the Superintendent of the Naval Observatory), the accordance between the results of these signals and the star observations was complete within $0^s.03$. At local mean noon on Dec. 5th, the clock was slow $14^s.88$, and gaining $0^s.030$ hourly. A mean-time clock, in the same room with the sidereal, was kept in continual comparison with it, both of the clocks recording their beats upon the same chronograph sheets all through the Transit.

III. Observers and Instruments.

1. Dr. S. Alexander, Professor Emeritus of Astronomy. This gentleman used a $3\frac{1}{2}$-inch telescope by Fraunhofer, equatorially mounted. The eye-piece was an erecting one with a power of about 80, and a thick, neutral-tint shade glass. Dr. Alexander took his time from a mean-time chronometer, which was compared with the observatory clock before and after the observations.

2. Professor C. A. Young, in the Halsted Observatory. The instrument was the great 23-inch equatorial of 30 feet focus, with a polarizing helioscope, the first reflecting prism of which is hollow and filled with water circulating through it. The magnifying powers used in the observation of the contacts was 160. At the two internal contacts the aperture was reduced to $5\frac{3}{4}$ inches, in order to make the observations comparable as far as possible with those of the various government expeditions. At the external contacts and during all the micrometric and spectroscopic observations the full aperture was employed.

3. Professor C. G. Rockwood, also in the Halsted Observatory. He used a dialytic telescope of 4 inches aperture belonging to himself; it was equatorially mounted, and had the usual reflecting solar eye-piece with magnifying power of 113.

4. C. I. Young (son of Professor Young). His instrument was the finder of the great equatorial; aperture 5 inches; reflecting solar eye-piece with power of 109.

At the School of Science Observatory there were six observers, viz:

5. Professor C. F. Brackett (in charge of the photographic operations). He observed the contacts with the equatorial of the S. S. Observatory; aperture $9\frac{1}{2}$ inches, which was reduced to $5\frac{3}{4}$ inches at all the contacts except the first. The eye-piece was a Merz polarizing helioscope, with magnifying power of 164.

6. M. McNeill, Instructor in Astronomy. His instrument was an equatorial mounted on a post in the open air. Aperture 4 inches; reflecting eye-piece with power of 162.

7. Professor W. Libbey, Jr. Portable equatorial of 3 inches aperture; reflecting eye-piece and power of 96.

8. W. F. Magie, Instructor in Physics. He used the finder of the 9½-inch equatorial. Aperture 3 inches; reflecting eye-piece and power of 124.

9. H. Crew, Fellow of the College. His instrument was an altazimuth of 3 inches aperture, reflecting eye-piece, power 80.

10. H. L. Baldwin, student. Altazimuth of 3 inches aperture, with reflecting eye-piece and power of 80.

In addition to these observers, two squads of students, eleven in all, observed images of the sun thrown upon screens by a 9-inch Newtonian reflector and a 5½-inch comet seeker. The results, however, are hardly satisfactory enough to be given here, though they will be published in another connection at some future time.

At South Hadley, the third and fourth contacts were observed by Mr. R. F. West, a graduate student of astronomy in Princeton, who was sent (by the liberality of Professor Libbey), to utilize the fine instruments of Mt. Holyoke Seminary, an institution with which the writer has been long connected as a lecturer. The telescope is an 8-inch equatorial by Clark. The whole aperture was used, with a reflecting eye-piece and magnifying power of 175.

The local time at South Hadley was determined by transit-instrument observations on Dec. 6th and 7th, and the approximate longitude by time-signals received at the telegraph office from Cambridge on Dec. 5th and 6th, and compared with the observatory clock by means of a box chronometer carried about a thousand feet. Unfortunately the performance of the chronometer during its short journeys was unsatisfactory, and the resulting longitude is doubtful by the amount of one second at least, and possibly two. The latitude was determined by the writer a year ago, by the zenith telescope method.

For three or four weeks before the Transit all the observers had practiced with an artificial transit as opportunity offered.

IV. Weather.

At Princeton, at the time of the first contact, there were numerous thin clouds, near the ground and flying rapidly, so that observers only a few rods apart were quite differently affected. At the second contact it was clearer; at the third the clouds were very troublesome; and at the fourth it was clearer again. The temperature was between 40° and 45° F.,

all through the Transit, and there was a fresh breeze from the southwest. The seeing was generally very good as regards distinctness, though after noon it was less satisfactory.

At South Hadley thick clouds prevented all observation of the first two contacts; then occasional breaks appeared between the clouds, and at the end of the Transit it was clear, though the seeing was very bad and unsteady.

V. Observations of Contacts.

We present the observations in tabular form, each contact by itself:

Observations of First (External) Contact.

Observer.	Washington Mean Time.	Observer's Remarks.
2. C. A. Y.	20h 55m 34s	Slight hardening of sun's limb suspected at the predicted point.
	55 40	Unmistakable. Contact noted. (*a*)
	55 50	Notch now obvious. 15° or 20° of planet's limb.
3. C. G. R.	56 20	Edge unsteady; numerous notches seen; one of them apparently permanent.
	56 40	Venus clearly on sun.
4. C. I. Y.	55 50	Suspected alteration of sun's edge for some seconds—limb boiling.
	55 58	Disturbance of limb obvious.
	56 02	Edge of planet distinctly seen.
5. C. F. B.	56 30	Planet's whole disc suddenly became visible in contact with sun. 20°—25° of planet's limb. (*b*)
6. M. McN.	56 00	Notch first seen. Sun faint. 20°—25° of planet's limb on sun. (*c*)
	56 40	Planet well entered.
7. W. L., Jr.	55 48	Evident notch. Sun's limb sharp. (*d*)
8. W. F. M.	56 46	Planet first seen. Well on sun.
9. H. C.	56 59	Planet first seen; some distance on sun.
10. H. L. B.	56 34	Indentation first perceived. Definition not very good.

Notes on First Contact.

(*a*.) I think this time of contact cannot be wrong by more than a very few seconds, though it may possibly be a little late. The effect noticed 6 seconds earlier was probably due to the obscuration of the chromosphere. The planet's outline was not seen before contact, and did not become visible to me until some ten minutes later.

(*b*.) Probably at this moment the sun came into a clear space between the clouds.

(*c*.) Mr. McNeill's estimate of 20°—25° of planet's limb on the sun indicates a time of contact closely accordant with my own observation—not more than 4 or 5 seconds later certainly.

(*d*.) Mr. Libbey's observation seems to be an excellent one; all that follow are obviously too late.

None of the observers caught a glimpse of the planet's disc before contact. Mr. Brackett's observation shows that the clouds were the probable hindrance.

OBSERVATIONS OF SECOND CONTACT (INTERNAL).

Observer.	Washington Mean Time.	Observer's Remarks.
1. S. A.	$21^h\ 16^m\ 08^s$	Excessively fine line at angle of contact of the two discs. Possibly early. (*a*)
2. C. A. Y.	15 56·2	Dark limb of planet tangent to sun's limb ideally produced across planet's atmosphere.
	16 06	Planet's atmosphere still projects beyond outline of sun's limb, forming a lump.
	16 18·6	Sun's limb resumes its form—lump vanishes. Contact noted.
	16 26	Contact clearly past. (*b*)
3. C. G. R.	16 24	Limb of sun complete; black drop not very evident; perhaps 2 seconds too early.
	16 30	Sure edge of sun was complete around Venus.
4. C. I. Y.	15 56	Dark fringe between Venus and sun fades into gray.
	16 16	Fringe becomes white.
	16 26	Venus distinctly on sun.
5. C. F. B.	16 15	Black band formed. Apparent geometrical contact.
	16 26	First continuous separation of limbs.
6. M. McN.	16 06	Not on.
	16 19	Light appeared all around planet, yellowish like edge of the sun. Probably about 2 seconds after contact.
	16 31	Planet clearly on sun. (*c*)
7. W. L., Jr.	16 08	At this moment a gray streak took the place of the black ligament between the cusps.
8. W. F. M.	16 30	Shade between limbs of planet and sun became gray.
	16 34	Sure white.
9. H. C.	15 56	First meeting of the two horns.
	16 36	Planet certainly on sun's disk.
10. H. L. B.	$21^h\ 16^m\ 12^s$	Considerable black drop, but breaking of ligament well seen, and almost instantaneous.

NOTES ON SECOND CONTACT.

(*a.*) The original record of Dr. Alexander's observations reads *two minutes* earlier; but he thinks a mistake as to the minute was made by the person who recorded for him.

(*b.*) The planet's atmosphere was finely seen, and embarrassed the observation. For more than 20 seconds it formed a lump projecting from the sun's limb. The seeing was so good that the granulation of the sun's surface was well seen, though there was considerable haze.

(*c.*) Mr. McNeill estimates the time of contact as $21^h\ 16^m\ 17^s$, W. M. T., deducting 2 seconds from the time recorded.

OBSERVATIONS OF THIRD CONTACT (INTERNAL).

Observer.	Washington Mean Time.	Observer's Remarks.
1. S. A.	$2^h\ 30^m\ 49^s$	Very satisfactory—no black drop.
2. C. A. Y.	2 39 27·2	Geometrical contact; apparently not doubtful more than a second or two. Clouds pretty thick. (*a*)
	39 33	Contact certainly past.
3. C. G. R.	39 33	Wind shook telescope; very hazy; not sure that contact was past for 20 seconds more.
4. C. I. Y.	39 12	Contact. Observation through clouds; limbs boiling badly.
	39 34	Cusps now distinctly formed.
5. C. F. B.	39 43	Very narrow gray space between the limbs.
	39 47	Black band connects edges of sun and planet.
6. M. McN.	38 59	Contact—not reliable. Clouds very thick and images very faint.
	39 53	Contact clearly past.
7. W. L., Jr.	39 43	No black drop. Geometrical.
8. W. F. M.	39 47	Black drop clearly seen joining sun and Venus.
9. H. C.	38 34	First suspected contact. (*b*)
	39 04	Certain that contact was over.
10. H. L. B.	39 46	Very little black drop. Sun indistinct through clouds.
	At South Hadley.	
11. R. H. W.	$2^h\ 39^m\ 22^s$	Formation of black drop. Geometrical contact at least 10 seconds later.

NOTES ON THIRD CONTACT.

(*a*.) The clouds at the Halsted Observatory were not quite so thick as at the other stations, and this may account for some of the discrepancies. Observers 1, 5, 7, 8 and 10 seem to agree very well upon a time some 10 to 15 seconds after 2 was sure that the contact was past. The planet's atmosphere was invisible to all the observers alike, but at the Halsted Observatory the seeing was fairly steady, and the contact seemed to take place so promptly that the writer felt justified in recording even the fraction of a section.

(*b*.) Query: error of one minute.

The clouds at this contact were more troublesome than at either of the other three, and the observations are probably less reliable.

OBSERVATIONS OF FOURTH CONTACT.

Observer.	Washington Mean Time.	Observer's Remarks.
2. C. A. Y.	$3^h\ 00^m\ 13^s{\cdot}5$	Notch disappeared promptly. No traces lingering on limb.
3. C. G. R.	3 00 02	Last moment when notch was *certainly* seen.
4. C. I. Y.	3 00 14	Disappearance of notch.
5. C. F. B.	3 00 08	Planet broke contact with sun.
	00 22	Momentary renewal of disturbance of limb at point of rupture.
6. M. McN.	3 00 00	Last trace of notch.
7. W. L., Jr.	3 00 00	Last trace of notch.
8. W. F. M.	3 00 06	Lost sight of planet.
9. H. C.	2 59 50	Last seen of Venus.
10. H. L. B.	3 00 29	Unsteady. Venus disappearing and reappearing.
	At South Hadley.	
11. R. F. W.	$2^h\ 58^m\ 30^s$	Very unsteady. Time probably much too early.

At Princeton, at the time of this last contact, there was comparatively little cloud, but the air was very unsteady and the sun's limb was serrated. Nothing was seen of the planet's atmosphere between third and fourth contacts except that for a few moments, about $2^h\ 45^m$, W. M. T., the writer saw fine spurs of light running out a little way from the sun's limb on each side of the planet's disc.

VI. MICROMETRIC MEASURES.

During the Transit I made two sets of measures of the planet's diameter; one with a double-image micrometer, the other with a filar micrometer. The screw-values of the two instruments were obtained a few days after the Transit (when the temperature was about the same as on Dec. 6th) by means of several hundred transits of small sun-spots across wires, observed with the chronograph.

The double-image measures consisted of 4 sets, each of 10 readings. They give:

For the north and south diameter (pos. ang. 0° and 180°), $62''{\cdot}33$
" east and west " (" 90° and 270°), $61''{\cdot}89$

Mean ..... $62''{\cdot}11$
Reduced to unity distance, $16''{\cdot}43$.

The filar micrometer measures consisted of 8 sets of 10 readings each, at position angles differing by 45°. They give:

Pos. angle,	0° and 180°	64″·29
"	40° and 225°	64″·43
"	90° and 270°	63″·93
"	135° and 315°	64″·57
Mean		64″·23

Reduced to distance unity, 16″·99.

The difference of 2″·1 between the double-image and filar micrometer is more than would have been anticipated, and I am not now able to explain its magnitude. I shall reëxamine the micrometer constants, but suspect the difficulty lies in the observer.

The double-image micrometer gave a power of about 600, and the images were always very pale and sometimes almost invisible; they were at no time sharply defined, clouds being very troublesome nearly all the time. The power used on the filar micrometer was about 250. During its use the seeing was much better than it had been during the double-image observations; it was never really very bad, and much of the time it was very good, so that the details of the solar surface came out finely.

VII. Spectroscopic Observations.

Spectroscopic observations were made both by Mr. McNeill and myself. Immediately after second contact I uncovered the whole aperture of the telescope, and attached the Clark spectroscope with a diffraction grating of about 17,000 lines to the inch. The slit was made tangent to the limb of the planet at the point most remote from the sun's center. I first tried the spectrum of the first order, examining specially B, *a*, and the interval between C and D. The clouds at the time were pretty thick and the results were negative, except that now and then I thought D_1 was a little intensified. A little later the sun came out brilliantly, and I at once turned to the third order spectrum. B and *a* still remained unaffected, nor could I make out certainly anything due to the planet's atmosphere between C and D. *But the vapor lines just below D_1 and between D_1 and D_2 were unmistakably intensified close to the planet's limb.* The same thing could also now be seen in the spectra of the first and second orders. I prepared to replace the grating by a prism giving low dispersion in order to search for diffuse bands of absorption, but the clouds thickened again, and the obscuration continued so long that it became necessary to exchange the spectroscope for the double-image micrometer.

Mr. McNeill's observations were made with the 9½-inch equatorial, carrying the Grubb spectroscope. This has a dispersive power of from 2 to 10 prisms, variable at pleasure. During the observations 4 prisms were used for the most part (i. e. 2 prisms transmitting the light twice). Mr. McNeill saw the vapor lines between and near the D's, and thought he noticed a slight strengthening of both A and B. He did not observe any change in *a*, but a fine line just above C was intensified, and the line at 759·2 of Kirchoff's scale (λ=6392) appeared to be distinctly affected.

At South Hadley Mr. West attempted observations with a grating spectroscope upon the 8-inch equatorial, but did not get any results; the image of the planet was too unsteady.

The effects of the planet's atmosphere upon the spectrum were certainly much less marked than I had expected; but I think there can be little doubt as to lines of aqueous vapor near D.

VIII. Photographic Work.

During the Transit a series of 191 photographs were taken by Professor Brackett and his assistants, Professor Libbey and Mr. Magie. The apparatus was a horizontal photoheliograph of the same general plan and dimensions as those used by our Government parties. The plates and chemicals were furnished by the Transit of Venus Commission, which receives the pictures for measurement and discussion.

The wind and clouds interfered somewhat with the operations. About 40 of the photographs are strictly first-class, and some 30 are worthless; the remainder are of all grades of excellence, from very good to very poor, but are probably all measurable.

Miscellaneous.

The atmosphere of the planet was seen by all the observers at Princeton between the first and second contacts. No one, however, saw the peculiar enlargement of the ring of light noticed by Professor Langley at Allegheny, though I did particularly observe that the structure of the ring appeared to be radiate and bristling, with scintillant knots here and there. No satellite was detected. No ring was seen on the sun's disc surrounding the planet except such as would necessarily result from the imperfect color-correction of the object-glass. No spots or markings were seen upon the planet's disc, which at ingress appeared slightly but distinctly darker than the background on which it was projected.

March, 1883.

ART. XXXIII.—*Notes on the Occurrence of certain Minerals in Amelia County, Virginia;* by WM. F. FONTAINE.

IN Amelia County, Virginia, near the county-seat, a considerable amount of excavation has been made during the past few years for the purpose of obtaining mica. This work has brought to light a number of interesting, and some very rare minerals. I have several times visited this locality and noted the occurrence of the minerals found there. It is my purpose in this paper to make known some of the facts observed.

All the minerals noticed in this paper occur in so-called veins of gigantic granite, situated in the immediate vicinity of Amelia Court House. These granite veins have the same general features as those that in other regions afford marketable mica. They are not fissure veins, but are ruptured portions of the country rock, into which the components of the granite have been introduced, most probably, by solution in hot water. The vein matter is chiefly a mixture of quartz and feldspar which serves as a gangue in which the masses and crystals of mica occur in a porphyritic manner. Sometimes, however, all of these minerals occur forming a confused web or entangled mass.

This material forms bosses, or irregular and interrupted veins in a thinly-bedded, highly micaceous gneiss that alternates with or graduates into mica-schist. The rocks are thoroughly metamorphosed, and their constituents occur in well individualized and rather coarse particles. These rocks form a belt that has the character attributed to the typical Montalban formation. The belt now in question may be traced for a long distance to the northeast and southwest of Amelia, and is usually marked by the occurrence of the veins of gigantic granite. It lies just west of the granitoid gneiss that is so extensively quarried near Richmond.

The vein-like deposits of granitic matter seem to occur in a pretty well defined band, but are not continuous over long distances. They occur more commonly "en echelon," sometimes overlapping each other. Some of them, over limited distances at least, seem at one time to have been open crevices. Some have remained undisturbed since their first filling, but others have evidently been reopened or disturbed more than once, and have received new materials.

The feldspar, mica and quartz, the essential minerals of these deposits, appear to have pretty constantly consolidated and crystallized in the same order of succession. The mica was the first to crystallize; the feldspar came next; and the quartz was the last to assume the solid form.

It is quite evident that some of these deposits near Amelia C. H. have in prehistoric times been worked to some extent. On opening the deposit near the village that has afforded the largest amount of mica, I am informed it was found that the outcrop had been removed for the depth of about ten feet. Refuse mica, stones and clay were then thrown back into the excavation. At a spot about two miles distant from this, I saw myself indications that the outcrop of a mica deposit had been disturbed. For the depth of ten or twelve feet, the earth had either been thrown in, or washed in upon the deposit which had been removed to that depth. On the top of the undisturbed deposit, and under about twelve feet of foreign earth, small bits of charcoal could be found.

Plates of mica that have an accurate rhombic shape, may be found here. They appear to have been trimmed into that form.

It is quite possible that these slight excavations were made by Indians, perhaps from curiosity. About two miles from this spot is a considerable outcrop of potstone that has been quite extensively worked by Indians, for the manufacture of pots and other utensils. This locality has been explored by the Smithsonian Institution, and has yielded quite a number of relics.

The most extensive excavations for mica have been made on the land of Mr. Rutherford, about one mile north of the Court House. Here two pits were dug, one on a hill of small altitude, and the other about one hundred yards distant, on a small stream. Both openings seem to be on the same deposit, but, as they show considerable differences in the occurrence of the minerals, it will be necessary to distinguish them. The one on the hill may be called No. 1, and that on the stream No. 2. Neither exceeds eighty feet in depth. From these two pits all the rare minerals have been taken.

The quartz found here shows no points worthy of mention. The mica is mostly muscovite. It is clear, and without color. Occasionally small particles of a beautiful rose-red mica are found. More commonly, but still rarely, a pale, yellowish green mica occurs that looks as if it were colored by uranium. The muscovite is sometimes bent, showing movements in the vein.

Feldspar.—The feldspar presents some points worthy of note. Much the larger part of the feldspar found in both pits is orthoclase. That found in pit No. 1 is mostly, when fresh, light-greenish in color. The feldspar of pit No. 2 is mainly yellowish-white. The orthoclase in both of these pits is nearly always found in crystalline masses. At an opening made some two miles to the northeast of these pits, which may be called pit No. 3, a nest of very large orthoclase crystals was

found. One of them, which is not the largest, is in the form of a rectangular prism, formed of the faces *O* and *i*$\bar{1}$ much prolonged. It has at one end several prismatic faces, while the other end is broken, since it formed the place of attachment. This crystal is 50 centimeters long, while the cross-section shows in one direction the dimension of 22½ centimeters, and in the other 20 centimeters.

Pit No. 1 shows but little feldspar other than orthoclase, but a considerable amount of albite occurs in pit No. 2. The larger part of this albite occurs in forms that I have seen assumed sometimes by stalagmitic deposits when they fill up vertical crevices in limestone, and there is little doubt but that this albite results from a secondary deposition of material, that made its way into an open crevice in the mass of material first deposited. This albite, for a depth of over twenty feet, formed a portion of the deposit composed of a closely-interlocked network of plates of a beautiful bluish-white material. Often angular cavities and cells were left from the incomplete filling of the space. At the bottom of this cellular mass, an open cavity was found, four or five feet long and high, and one or two feet wide. In the bluish white albite, and in the walls of this cavity, some minerals were found that do not occur elsewhere. Numerous crystals of smoky quartz lined the walls of this cavity along with pure white crystals of albite, some as transparent as glass. The quartz has often mingled with it a greenish powder that is evidently a decomposition product. The minerals found here were evidently deposited after the formation of the mass of granitic material, forming the bulk of the vein.

A small amount of labradorite occurs dispersed in a porphyritic manner in the masses of orthoclase. It is usually of a smoke-gray color, and sometimes shows a slight change of color on turning the specimens.

A considerable amount of amazon stone is found, but most of it occurs in pit No. 2. It ranges in color from bluish-green to verdigris green. The mode of occurrence of this feldspar strongly suggests the idea that the color comes from solutions infiltrating into the deposit from the surface, and making their way through the crevices of the vein. The green color most commonly is deepest in the portions of a mass of spar next to a fissure, or line of dislocation, and fades gradually until it is entirely lost in the mass of the material. Hence, often, hand specimens will be only partly colored.

Beryl.—The beryls, which occur of large size and quite commonly, are found almost wholly in pit No. 2. Some of them are surpassed in size only by those of New Hampshire. They are found sometimes three or four feet in length, and as much

as eighteen inches in diameter. The most common colors are pale bluish green and dingy yellow. The latter color is so much like that of some of the feldspar, that it is sometimes difficult to distinguish the two minerals. The beryls seem to have crystallized at the same time with the feldspar and after the mica. Some masses are formed of the yellowish feldspar and beryl so closely consolidated, that they seem to shade off into each other. In the quartz, however, the beryl crystals are easily separated, and leave sharp imprints of their crystalline form. I have seen one beryl crystal that shows crystals of mica projecting from its prismatic faces, and in several places, where the mica had fallen out, a distinct imprint of its crystalline form was left in the beryl.

All the beryls found in the two pits are opaque, but in pockets of quartz found in the vicinity, small transparent crystals, half a centimeter thick and under occur, that have a good luster, but not a deep color.

Fluorite.—This mineral occurs not rarely, and mostly in pit No. 2. I have never seen it in crystals. It is found always in crystalline masses that shatter easily into small fragments. Only a few particles show good cleavage. The mineral is usually found occupying the irregular angular spaces left between the particles of the feldspar, mica and quartz. Two colors predominate, a pale purple and a pale green. Some fragments show a very deep, dark green color. The fluorite is remarkable for the great beauty and brilliancy of the phosphorescent light that it gives out at quite low temperatures. The light is rich bluish green in color. After decrepitation it no longer gives out light.

Columbite.—This mineral occurs quite commonly, and it is more abundant in pit No. 2 than in pit No. 1. It is found quite often in crystals, some of them being of large size. They are, however, very easily broken, and can almost never be gotten entire from the feldspar, which is always the mineral that contains them. Some crystalline masses weighing six to eight pounds exist. I have one mass which is an aggregation of crystals that shows the following dimensions: length 12 centimeters, width 11½ centimeters and thickness 11 centimeters. It appears to be a mass formed by the aggregation of crystals that have a flat shape from the predominance of the $i\bar{i}$ faces. All of the masses of columbite found here are friable and easily break up into angular fragments.

A variety of columbite occurs here rather rarely, that differs from the normal mineral both in chemical and physical characters.* This, as Professor Dunnington has shown, contains con-

* A somewhat similar mineral had been previously found at Branchville, Conn., and analyzed by Comstock.

siderably more manganese than iron, and has the ratio of columbic to tantalic acid 1 : 1. In mass it has a dark chestnut-brown to dark reddish brown color. Some particles tend to assume a fibrous structure, and then the color is somewhat lighter. In very thin splinters the color is a rich hyacinth-red. The normal columbite, so far as known, is the only kind that occurs in the upper part of the vein. The variety now in question is found only in pit No. 2, and becomes more abundant with increasing depth. Mr. Search, a gentleman connected with the mining operations and a zealous collector of the rare minerals found there, informs me that just before the pit was abandoned he found in the walls, a few feet above the bottom, a mass of this variety of columbite that weighed about five pounds. Portions of this mass in my possession show the tendency to assume a fibrous structure. These fragments are much like some kinds of rutile. For the analysis of this variety of columbite, the reader may consult the account of it given by Professor Dunnington, in the Am. Chem. Jour., vol. iv, p. 138. The columbite crystallized before the feldspar, and leaves in it well-defined imprints of its form.

Garnet.—In pit No. 2, garnet of the variety spessartite is quite common, forming one of the primitive minerals of the vein. This garnet occurs in poorly formed crystals that are penetrated with a multitude of fissures, so that the mineral readily shatters to pieces. This form has a hyacinth-red to brownish red color, and is imbedded in the ordinary feldspar of the vein stuff. This mention is made of it to distinguish this kind of garnet from another of the same variety, viz: spessartite, that shows quite a different mode of occurrence, and which is specially noteworthy on account of its intimate connection with helvite. This second form of spessartite occurs in the form of a loosely aggregated mass, composed of granules and angular particles, but never in crystals. The granular mass is intimately mixed with helvite, the latter filling the interstices between the particles of spessartite. The compound is inserted in the cavities left between the interlacing crystals of albite that were formed on the walls of the large cavity discovered in pit No. 2. Both this spessartite and the helvite are clearly minerals deposited in the vein after the filling of the greater portion of it by the more abundant materials composing the vein stuff. The order of deposition seems to have been as follows. First, the beautifully clear albite crystals were formed on the walls of the cavity, producing an open network with large interstices. In some of these the spessartite was loosely deposited, and lastly, in some of the cavities between the particles of spessartite helvite was laid down. The helvite is very rare, and does not occur associated with all of the spessartite.

The spessartite thus associated with helvite has the following characters. Fusibility = 3 ; hardness = 6·5 ; sp. gr. = 4·20. Composition :

SiO_2	36·34
Al_2O_3	12·63
FeO	4·57
MnO	44·20
CaO	1·49
MgO	·47
Water	a faint trace.
	99·70

The color is pale pink to flesh-red. Some fragments are brownish purple. The mineral looks more like some rhodonite than like garnet. It will be noted that the manganese is unusually high, and the iron and alumina unusually low.

The above analysis, with the determination of the specific gravity and hardness, was made by Mr. C. M. Bradbury in the laboratory of the University of Virginia.

Orthite.—Orthite is found in great abundance at the locality, pit No. 3, that furnishes the very large feldspar crystals mentioned above. Here some of the thin-bladed crystals may be seen more than fifteen inches long. It is also not rare in pit No. 2, but here the crystals rarely show lengths exceeding six to eight inches. In all cases both ends are broken off. Those of the greatest length do not exceed in thickness 4^{mm} and in width 2 to $2\frac{1}{2}^{cm}$. In shape they are much like an ordinary ivory paper cutter.

The mineral, so far as I have observed, always occurs imbedded in feldspar or a mixture of feldspar and quartz. It usually has a decomposition crust of varying thickness, and sometimes the whole crystal is altered. The crust has an ash-gray color and is without luster. It is sharply distinct from the fresh interior. The internal sound portion has a velvet-black color and a high pitchy luster.

This mineral has been analyzed, independently, by Professors Kœnig and Dunnington. For the analysis of Professor Kœnig, see Proc. Acad. Nat. Sci. Philadelphia, 1882, p. 103 ; for that of Professor Dunnington, the Am. Chem. Jour., vol. iv, p. 138, may be consulted.

Microlite.—This is the most interesting of the minerals found in the mica mines of Amelia County. It occurs only at pits Nos. 1 and 2. I have carefully looked for it at the other openings made for mica in the vicinity without finding it. The largest masses were found in pit No. 1, some twenty feet below the surface. These masses occurred in the northern end

of the pit, and occupied the interstices left in the tangled mass of quartz, feldspar and mica that forms the main portion of the vein-stuff. The microlite, whether in crystalline masses, or in distinct crystals, was one of the original minerals of the vein. It crystallized after the mica, for some of the specimens have the faces distinctly marked by the overlapping edges of plates of mica, but before the feldspar, for the crystals are usually imbedded in feldspar, and leave sharp impressions in it. The larger masses of the mineral are aggregates of crystals, and show often on the component parts several crystal faces. The single crystals, which are most numerous in pit No. 2, occur imbedded mostly in feldspar, but they are sometimes found in quartz, or in a web of quartz and mica. It is noteworthy that minute crystals are very rare. I have seen a few from 3 to 5^{mm} in diameter, imbedded in quartz. The well-formed single crystals have usually the diameter of 1 to 1½^{cm}. Microlite occurs also in the walls of the cavity that was found in pit No. 2, along with the albite crystals.

At the first discovery of the microlite of Amelia, the existence of monazite was overlooked, because the specimens that had then been found were much like microlite. The slight difference in appearance was accounted for by the assumption that the microlite had been decomposed or altered to some extent. Hence, in the publication of his article on microlite, in the Am. Chem. Jour., III, ii, 130, Professor Dunnington gave as the weight of one mass of microlite eight pounds. This specimen was really monazite, as subsequent analysis showed. This mistake, however, would not lead to erroneous conclusions concerning the size that some of the microlite specimens attain. I have a fragment of microlite that, no doubt, was originally not inferior in weight to the above-mentioned specimen of monazite. This fragment of microlite when found had been broken off from a much larger mass, as is shown by the surface of fresh fracture. The portion in my possession weighs four pounds fifteen ounces. The whole mass must have weighed over eight pounds. This specimen is an interesting one. It is composed of a number of distorted octahedral crystals of large size, united in an irregular manner. On one side the surface is marked with imprints caused by the overlapping plates of mica, under the edges of which the microlite was deposited. The color of the microlite varies a good deal. The colors range from pale yellowish gray, through brownish yellow to dark hair-brown. The brownish yellow color is that of the best characterized fresh material. This color, with the high resinous luster, and the broad, shallow conchoidal fracture, often causes the mineral to look like some of the gums. The single crystals show constantly the same forms.

They are octahedrons, modified by small faces of *O*, *I*, and *m-m*. All the faces of the same form are not always present, and when present, they are usually not equally developed. The largest single crystal that I have seen is slightly distorted. The longest axis has the dimension of $4\frac{1}{2}^{cm}$. In the direction of the other axes, it measures about 3^{mm} less. This crystal in forming has caught up, and partially imbedded some columbite. This would indicate the prior formation of the columbite, but this is not true of all the columbite, for it sometimes imbeds portions of microlite. This difference results from the fact that microlite was deposited at different times, some being found as stated, with the albite, helvite, etc., in the walls of the cavity previously mentioned.

The microlite seems to be a very durable substance. As illustrating this, the fact may be mentioned that a fragment of feldspar was found containing a number of crystals of microlite. The feldspar was almost wholly changed to kaolin, while the microlite retained its luster and hardness. Professor Dunnington, in the article above mentioned, has given the analysis and description of this mineral.

Monazite.—Monazite has been found nowhere except at pits 1 and 2. It occurs much as the microlite does, and is often so much like it that it requires close inspection to distinguish the two minerals. It exists usually in larger masses than the microlite, and what is peculiar, never in single or small crystals. The masses, however, are aggregations of distorted crystals, and often show on the constituent parts, well-formed crystal faces. Another noteworthy fact may be mentioned. Cleavage is either wholly absent, or present only in traces. The fracture is very uneven and rough. This is the best means to distinguish it from microlite. The large masses are often formed by the aggregation of imperfect flattened crystals, the plane of junction being the *ii* faces. Some of these masses have much the shape of some of the aggregations of columbite.

Two colors are common in this mineral. One is yellowish brown, and the other dark grayish brown. In the mineral with the latter color, numerous fine particles of silvery-white mica are often found. Besides the above, an orange color is sometimes seen. The different colors often occur together, the same specimen showing them in different parts. This mineral does not seem to have formed one of the later deposited ones, as it is not found in the cavity associated with albite, etc. The monazite is decidedly more prone to alteration than the microlite. It is sometimes found with an earthy texture, having lost its luster and become more gray in color.

Professor G. A. Kœnig first recognized monazite among the Amelia minerals. For his analysis, see Proc. Acad. Nat. Sci.

Philad., June 24, 1882. Professor Dunnington has analyzed this monazite also. For his results, see Am. Chem. Jour., vol. iv, p. 138. The most noteworthy feature of this analysis is the considerable amount of thorina found.*

Helvite.—This mineral occurs very rarely, and is found only in pit No. 2. It seems to occur only in the walls of the cavity in this pit, and is deposited in the interstices of the light pink spessartite mentioned above, which is itself found in the openings between the albite crystals that formed on the walls of the open space. The helvite seems to have been the last mineral to be deposited in the vein, and its constant association with such a highly manganiferous garnet, is an interesting feature. It seems to have been deposited in the form of crystalline granular particles, that rarely show crystal faces or forms. A good deal of it is now in a pulverulent condition that may result from partial alteration. This mineral has been carefully examined in the laboratory of the University of Virginia by Mr. B. E. Sloan, pure material being taken. I extract the results of this examination from the "Notes of Work of Students," etc., etc., published originally in the London Chemical News.

"Color, wax- to lemon-yellow; streak, very pale lemon-yellow; luster, vitreous; translucent; hardness = 6; sp. gr. = 3·25. Fusible before the blowpipe flame with intumescence. Decomposed by hydrochloric acid with the formation of gelatinous silicic acid, and the liberation of sulphuretted hydrogen. Analysis gave—

SiO_2,	31·42
BeO,	10·97
MnO,	40·56
FeO,	2·99
Al_2O_3,	0·36
Mn,	8·59
S,	4·90=99·88

Another interesting mineral was found in pit No. 2, but unfortunately in so very small amounts that a complete quantitative analysis of it could not be made without using all of the material. It shows no crystal faces, but the structure is much like that of the normal columbite that occurs at this mine. The color is pinchbeck-brown, with a tinge of purple, causing the mineral to look like bornite. The purple may be a color from partial alteration, as it is quite intense on some particles. The streak is very pale yellowish brown to flesh-red. Hardness=6·5. Sp. gr.=6·82. In composition it is a tantalate,

* Mr. S. L. Penfield, in his analyses published in this Journal in October, 1882 (xxiv, 250), concludes that the thorina present is from mixture with thorite.—Eds.

mainly of manganese, with a large amount of lime, and a small amount of iron. The examination was made by Mr. Dunnington who ascertained with certainty the absence of columbic acid. Possibly this mineral may be allied to Nordenskjöld's mangantantalite.

The following minerals also occur, but very rarely:

Galena.—Small fragments of galena are found sometimes in pit No. 2. The largest particles seen by me have the dimensions of from 3 to 5^{cm}. This galena is said to be argentiferous. It has not been tested here.

Stibnite.—Mr. G. W. Fiss, of Philadelphia, who has taken great interest in collecting the minerals of the Amelia mica mines, informs me that he has found stibnite among them in one piece. I have seen no pure stibnite, but have in my possession some fragments of mixed galena and stibnite.

Pyrochlore.—Mr. Fiss informs me that he has found a piece of pyrochlore also at these mines. I have seen none.

Apatite and black tourmaline occur very rarely in pits No. 1 and 2. A brick-red mineral also is found in very minute particles in pit No. 2. It has the hardness of fluorite, and gave Mr. W. H. Seamon reactions for cerium, indicating the presence of fluocerite.

One or two additional minerals from this locality remain to be more fully examined, and they will probably prove to be of interest.

University of Virginia, Jan. 27, 1883.

ART. XXXIV.—*On the Surface Limit or Thickness of the Continental Glacier in New Jersey and adjacent States;* by J. C. SMOCK, New Brunswick, N. J.

[Read at the Montreal meeting of the American Association for the Advancement of Science.]

A PAPER under the above title was presented by the author to the Association at the meeting at Saratoga Springs, in 1879. The discussion which followed its reading at that time suggested further explorations in the field and a general review of the whole question. The results of field work in 1880, 1881 and this season, with the revised data of previous years, have been incorporated in this paper.

It is proper here to put on record a reference to the work done in New Jersey in tracing the terminal moraine across that State. The existence of such a moraine and of a southern limit to the glacial drift in New Jersey was suggested to the author, in 1876, by Professor George H. Cook, State Geologist. Dur-

ing the summer of that year it was traced across the State from Perth Amboy to the Delaware River, near Belvidere. The work was the subject of a paper read at the Wilkesbarre meeting of the American Institute of Mining Engineers in May, 1877, by Professor Cook.* A short notice of it appeared in the annual report of the State Geologist for 1877.† In the next annual report of the State Geological Survey the moraine was more fully described and was represented upon a State map accompanying that report. The course across Staten Island and Long Island was given,—as the continuation of the New Jersey moraine. Its course in Pennsylvania was traced and described by Professor Frederick Prime, Jr., of the Geological Survey of that State.‡ The general subject of a continental moraine from Long Island westward, to Iowa and Minnesota, has been discussed by Professor T. C. Chamberlin, State Geologist of Wisconsin, in a memoir entitled, "On the Extent and Significance of the Wisconsin Kettle Moraine," published by the Wisconsin Academy of Sciences. Professor Chamberlin has correlated the eastern and western terminal moraines in an article in this Journal for August, 1882. The eastern continuation of the moraine, on Long Island, was described by Warren Upham, lately of the New Hampshire Geological Survey, in this Journal in 1879.§ The results of the labors of Professor H. C. Lewis of the Pennsylvania Geological Survey, in mapping out the southern limit of the ice sheet in Pennsylvania, have not yet appeared.

While engaged in tracing the course of the moraine in New Jersey, the questions of the thickness of the ice of the glacier and the rise of its upper slope, were suggested by the varying heights of its mounds and the absence of drift on the higher peaks which stood in its course. The terminal moraine represents materials pushed forward under the foot of the glacier, and also earth and stone carried on its surface and dropped as it melted and retreated northward. The heights of these accumulated heaps may in places have been equal to the greatest thickness of the ice front, although in general the moraine would fall short of that of the glacier. As we see it, this terminal moraine varies in height from point to point. The inequalities are no doubt largely owing to irregularities in the original deposition. But the denudation, which has been in progress ever since the ice began to melt, has probably done more in giving to it its present contours. It is possible to get a minimum estimate for the thickness of the ice from some of the

* Transactions Am. Inst. of Mining Engineers, vol. vi, pp. 467–470, Easton, Pa., 1879.

† Ann. Rep. of the State Geologist for 1877, pp. 10–11, Trenton, 1877.

‡ Proceedings of the Am. Philosophical Society, vol. xviii, p. 85.

§ This Journal. III, xviii, pp. 81–92, and 197–209.

elevations in the line of the moraine. Poplar Hill, near Woodbridge, New Jersey, is 240 feet above tide; Drift Hills near Clifton Station on Staten Island, 190 feet; Prospect Hill, Brooklyn, 194 feet; Harbor Hill, near Roslyn, Long Island, 384 feet; many others on Long Island are between 150 and 370 feet.* It is safe to conclude from these heights that the thickness of the ice sheet in this southern loop of the Hudson Valley was at least 200 to 400 feet. Other localities farther to the west and northwest furnish data of like nature. At Feltville in Union County, a bowlder limit is recognized at an elevation of 400 feet above tide. On Second Mountain, west of Feltville, there are scattered bowlders up to 440 feet. The general level of the sandstone plain on the east side of the First Mountain range is 150 feet, giving a difference of 250 to 290 feet as a measure of the ice at this point. Again, at Long Hill, near Chatham in Morris County, the glacial drift is wrapped about the north foot of the ridge and pushed forward to the south on each side. The upper bowlder limit here is 390 feet high. The Passaic River, flowing in the bottom of the red sandstone valley on the east of this hill, is 177 feet above tide or 200 feet below the bowlder line. Another locality, exhibiting like phases in the drift, is on Snake Hill, near Denville, also in Morris County. On the northern point of this sharp and rocky ridge of gneiss the moraine is traceable at an elevation of 670 feet, but scattered bowlders as high as 770 feet indicate the latter elevation as the ice limit. The crest line of this range is 910 feet high. On each side the drift sweeps southward, lying against the hill. The general level of the plain north of the hill is 570 feet, but the valley bottom or rock floor is lower and consequently the glacier must have been more than 200 feet thick as it encountered Snake Hill. It was not, however, thick enough to reach the crest. The glacial phenomena on the next hill to the west of Snake Hill are very similar to what has been mentioned above. Three ranges, approximately parallel, stood thus in the way of the glacier, and were partly covered by it. But their summits overtopped the ice and escaped glaciation. Dover in Morris County is at the foot of the moraine whose height above tide-level is at this place 640 feet. The rapid rise in the drift hills to 960 feet northward indicates that the ice sheet thickened rapidly in that direction. West of Dover the long valley, which may be designated as the Berkshire–Succasunna, exhibits some striking drift phenomena. Separate masses of glacial drift are here found lying about the northern ends of Potsdam sandstone ridges, while the intervening valley is filled with exceedingly

* Elias Lewis, Jr., in a note to Professor Dana in this Journal, III, vol. xiii, p. 235.

coarse bowlder drift, modified and made from the destruction of the once continuous moraine. These sandstone ridges also were but partially covered by the glacier as it here neared its most southern extension. The elevation of the drift upon them varies from 700 to 900 feet. The highest points on the Schooleys Mountain table-land are the summits of the moraine hills, which are 1,200 to 1,300 feet above tide. And this is the maximum elevation along the line of the moraine in New Jersey. From this height as compared with that of the Musconetcong Valley on the west, there is a descent of 700 feet, which becomes a measure of the ice as it lay in that valley. Westward the course of the moraine is more southwest. There was a loop or tongue projecting southward in the valley of the Delaware. At Tonnsbury in Warren County there is a bowlder limit on Mt. Mohepinoki at 950 feet, which is at least 450 feet above the bottom of the Pequest Valley at the village. The upper surface would seem to have been lower here than on Schooleys Mountain. In the valley of the Delaware the drift hills range from 490 to 560 feet in height and are 250 to 320 feet higher than the river. The erosion of the river bed may have been considerable since the close of the glacial period, and this difference may be more than equal to the thickness of the glacier which filled the valley at this place.

From these notes on the moraine elevations in New Jersey, the inference seems to be that the ice foot was highest in the Highlands and was there thicker than elsewhere in the limits of the State. The glacier pushed southward in the red sandstone plain and attained a latitude of 40° 30′, at the mouth of the Raritan River. The most southerly point at which we have any record of it, in the Delaware Valley, was near Belvidere,—in latitude 40° 50′. Both of these loops appear to have been thinner near their southern edges than the mass on the Highlands. The differences in elevation in these valleys and on the Highlands may give us the rate of increase in thickness from north to south. For example, at Dover the moraine is 22 miles north of the latitude of Perth Amboy, and the elevation at Dover is 640 feet. If at Amboy the ice was but little above or near the level of tide-water, the rate of descent would be nearly 30 feet per mile. Other examples could be cited, but they have been printed. (See Annual Report of the State Geologist of New Jersey for 1877, pp. 12-13.) The much greater rise per mile in the Delaware Valley shows that the rate was not uniform. Nor is it at all probable that measurements elsewhere will correspond in rate with the examples referred to above. Inequalities in the surface over which the ice moved, differences in the rate of accumulation of the snows and ice as well as in that of its wasting away and its retreat,

made uniformity in the front of the glacier for even 100 miles of its course impossible.

Recognizing the southern limit of the glacier and finding these evidences of its thickness along the terminal moraine, search was begun for points to the north which might have been high enough to have escaped glaciation. Finding such points we should have data for ascertaining the rate of rise in the upper slope of the ice. Existing glaciers, as those of Greenland, which are continental in extent, and the great ice cap of the Antarctic pole, give some hints of what we should expect to find among the records left us by our continental glacier. Professor Nordenskjöld states "that in Greenland, when at the extreme point which he reached, thirty geographical miles from the coast, he attained an elevation of 2200 feet, and that the inland ice *constantly continued to rise* toward the interior, so that the horizon toward the east, north and south, was terminated by an ice-border almost as smooth as that of the ocean."*

Dr. Hayes and his party penetrated inward to the distance of about seventy miles. At that distance the altitude was 5000 feet, but the ascent had diminished from 6° to 2° on the upper slope of the icy mass. But the ice has not covered some of the highest peaks of Greenland and they stand out as islands in the ice and are known as "ice-bare islands," or "*nunataks.*" One of the most noted of them explored by Lieutenant Jensen of the R. D. navy is about fifty miles from the west coast, north of Fredericshaab and rises 3000 feet above the ice, to a height of 5000 feet above sea level.† Here then we find a measure of the ice covering Greenland.‡

The observations of geologists upon glacial phenomena in Scotland, England and Switzerland indicate an upper limit to the ice of the glaciers, which formerly covered these countries. James Geikie, of H. M. Geological Survey, says in a paper on the "Glacial Phenomena of the Outer Hebrides:"§ "The actual thickness of the ice sheet it is now possible to measure with some approach to exactness. We have seen that the only points in the Outer Hebrides, which have escaped glaciation, are those that exceed a height of 1600 feet. Taking this, therefore, as the thickness of the ice that overflowed the lowest ground of the Long Island and 3000 feet as the probable upper

* "Climate and Time." James Croll, p. 379.

† Robert Brown in Enc. Brit., 9th ed. (N. Y., 1880), vol. xi, p. 167.

‡ Professor James D. Dana, in this Journal, August, 1882. vol. xxiv, pp. 100, 101, refers to the height of the ice in Greenland in the Glacial Era, as indicated by glacial scratches which were observed by Mr. A. Kornerup of Jensen's Expedition. These scratches were found at 940, 1100 and 1260 meters elevation. But none were found on the upper part of peaks. 1520 meters (4987 feet) high.

§ Quarterly Journal of the Geological Society for November, 1878, pp. 860–861.

limits of the ice sheet in Western Ross and Sutherland, we readily arrive at the depth of the ice sheet that filled up the Minch. . . . . Measuring from the Cliseam, in North Harris, to the mountains of Torridon, we have a distance of fifty-six miles, so that the inclination of the surface of the *Mer de Glace* was very little, the fall not being more than 1400 feet, or about 1 in 211. But slight as that incline was, it was probably twice as great as that of the *Mer de Glace* that filled up the German Ocean." This inclination, in other terms, is twenty-five feet per mile.

Professor A. C. Ramsay, Director of the Geological Survey of Great Britain, in his "Old Glaciers of Switzerland and North Wales," says: "All through Britain and Ireland this drift rises well up on the flanks of the mountains, and in Caernarvonshire and North Wales, generally, the surface, is over large areas more or less covered by true GLACIAL DRIFT, rising from underneath the sea to a height of about 2300 feet on some of the mountains."

In Switzerland, according to the Swiss geologists, a mighty *Mer de Glace* moved down from the Alps and carried huge blocks across the lower grounds to the Juras. "This vast sheet of ice not less than 3000 feet in thickness, stretched continuously outward from the Rhone Valley and abutted upon the Jura, the higher ridges of which rose above its level."*

These phenomena of the glacial drift in Europe, which have afforded data for measuring the thickness and the slope of the upper surface of the ice sheets of the glacial epoch, have suggested the examination of like phenomena in our territory, with a view to the discovery of facts of glaciation enabling us to get a measure of the continental glacier which covered the northern portion of our American continent.

A careful exploration of that part of New Jersey, which is north of the terminal moraine, has thus far failed to discover any peaks or crests which have escaped glaciation, or which show no marks of a glacier. An examination of the highest mountains of the New York Highlands and also of the lofty Schunemunk Mountains has discovered glacial markings on all of these high points.

The Shawangunk Mountain also is glaciated to its crest. The lofty table land of the Pokono Mountains in Pennsylvania near the line of the Delaware, Lackawanna & Western railroad, whose summit is 1970 feet above tide, was found covered by glacial drift. A single ridge, however, of this same range and same geological formation, known as Pokono Knob, eight miles west-northwest of Stroudsburg, Pa., appears to

* "The Great Ice Age," James Geikie, p. 371.

have stood above the ice. Bowlders and drift earth cover its flanks and constitute much of the surface material to within a vertical distance of 50 to 100 feet of the top. On the crest of the ridge the ledges of grayish white conglomerate are much broken up and lie in blocks. None of them show any glacial markings. Nor are there any erratics or drift earth on this crest. The absence of characteristic glacial phenomena leads to the conclusion that the ice did not attain this height. The mountain is 2025 feet high and the glacial limit may, therefore, be put at about 2000 feet. The whole country to the eastward and southeast, including the Kittatinny Mountain—at the Delaware Water Gap was covered by the glacier, and on it glacial markings are common.

But the testimony of Professor I. C. White, of the Pennsylvania Geological Survey, who has examined Pokono Knob is still more positive. He says: "During the past year (1881) I made the survey of Monroe County and ascended Pocono Knob, I was unable to find any evidences of glaciation, either of *scratches* or *drift* on its summit, hence I concluded that the deep valley of Pocono Creek to the east had lowered the upper limit of the ice, since on the Pocono plateau in Coolbaugh township, glacial striæ were observed at an elevation of 2150 feet (A. T.)"*

Professor White's survey of Susquehanna and Wayne Counties discovered several peaks on the border line of these counties which also escaped glaciation. Elk Mountain, Ararat and Sugar Loaf of the Moosic Highlands appear to have stood out, above the ice. Professor White says: "2200 feet (A. T.) is the greatest elevation at which I have observed direct evidence of glaciation, either in the shape of morainic débris or striated rock surfaces. All higher summits which I have examined are destitute of *drift deposits.*"† North Knob, the highest of these peaks, is 2700 feet high; South Knob rises to 2575 feet; while Sugar Loaf and Ararat are 2450 and 2600 feet, respectively. As remarked by Professor White: "These summits, which probably existed as elevated hills in pre-glacial times, were left as islands in the ice moving southward, and escaped the universal abrasion to which every other portion of the township was subjected; for no appearance of drift or glacial scratches can be found on their sides or summits." These driftless peaks are about sixty-five miles north of Belvidere, the most southern point reached by the glacier in the Delaware Valley. And the rate of rise in the upper slope

* Letter to the author of this paper from Professor White. Morgantown, W. Va., April 3d, 1882.

† "The Geology of Susquehanna County and Wayne County," by I. C. White, Harrisburg, 1881, pp. 25 and 158–159.

may have been near thirty-five feet per mile, although from the fact of the glaciation on the Pocono Highlands considerably farther south, we should infer that the rise was by no means uniform, but was much faster near the glacier front.

Sam's Point, the highest part of the Shawangunk range and 2341 feet high (according to Professor Guyot), which is in the same latitude as the Moosic Highlands, is glaciated to the top. Walnut Hill or Liberty Hill, in Sullivan County, New York, also exhibits glacial abrasion and drift to within 200 feet of its summit, or at an altitude of 2000 feet.

During a short visit to the Catskill Mountain region, in the summer of 1877, the great height of the western and southwestern peaks of that mountain group suggested the possibility of finding there the upper limit of the ice, and the ascent of Hunter Mountain was made that season. Visits have been made to this region each year since, and many of the more prominent, and all the higher peaks, have been ascended and their slopes and summits examined for glacial phenomena. The excellent and valuable map of Professor Guyot, published in 1879,* has served as a constant guide and furnished the data for elevations, although an independent series of barometric measurements has been taken and found to agree closely with the figures of Guyot's map. In this group of mountains there are at least fifty peaks which exceed 3000 feet, and three which are over 4000 feet high. The general trend of the mountain ranges is northwest and southeast, but the higher peaks stand on northeast and southwest lines. The amount of erosion in the Catskills has been very great, since the strata are nearly everywhere horizontal, or inclined but a few degrees from the horizon. The main valleys appear to have been eroded prior to the glacial epoch, and the existing features were largely determined by the long-continued wear of pre-glacial waters, so that the ice sheet did little beyond filling partly some of the valleys and abrading the more prominent of the lower ridges. The valleys are, essentially, of erosive origin, obscured, however, now by glacial débris in many places. In some of them, as that of the Batavia Kill in Windham, the Stony Clove and Woodland Valley, there are very plainly marked moraines, indicating the existence and retreat of local glaciers. The larger valleys of the Schoharie Kill, the east branch of the Delaware, and the Esopus Creek, also have their moraines, though not so well defined. Subsequent to the retreat of the great mass of the continental glacier these valleys were no doubt occupied by detached glaciers. The torrents flowing from them evidently modified much of the older drift and deposited it in a stratified form in these valley bottoms as we now

* This Journal, III, vol. xix, pp. 429–451.

see it. In this way the moraines were partly destroyed. Ascending these valleys to their head, the upper limits of the thick drift masses are reached, beyond which, on the steeper mountain slope, the explorer finds the evidences of glaciation in *roches moutonnées* and scattered bowlders only. The heights of these moraine limits vary somewhat in the different valleys. Thus, at the head of the Batavia Kill Valley and near Black Dome, it is about 2700 feet; west of the Catskill Mountain House, and near Tannersville, it is at least 2000 feet; on the northern slope of Hunter Mountain it is 2200 feet; in the Stony Clove Notch it is about 2000 feet; in the notch west of Slide Mountain, and at the headwaters of the Neversink, it is 2650 feet; near Summit Station, on the U. & D. railroad line, it is 2200 feet; near Margaretville, 2000 feet; on the southeast slope of Mt. Pisgah, northwest of Margaretville, it is 2800 feet; and near Stamford, at the head of the west branch of the Delaware, it is 2000 feet. Of course, it will be understood that these thicker glacial deposits are, to a great extent, determined by the configuration of the rocky floors or valleys in which they were deposited, and their elevation is, therefore, approximately that of these valleys. But, inasmuch as the slopes rise much higher, affording surface for deposition at greater altitudes, it is probable that the average of these elevations, from 2000 to 2800 feet, was the upper limit of the *moraine profonde*, or till. The scratched ledges, sub-angular bowlders and gravel, and the glacial earth, which lie on the higher slopes, indicate that the ice encountered the more elevated mountain sides and left its marks upon them. And this sparse drift was, doubtless, from the upper surface of the glacier. In order to ascertain the thickness of the ice the heights of these higher markings and deposits must be found. And here it should be stated that the examination of the higher slopes and the summits is rendered difficult by the accumulations of the forest growth upon them and by the wear of subaërial agencies, as frost and water, during the ages since the close of the glacial epoch. The action of frost may have obliterated all the more exposed markings. The rock also is not the best fitted to retain glacial marks. The results of our repeated visits to this region point to a general absence of all the more characteristic features of glaciation above an average elevation of 3000 feet above tide level. Above this horizon the forms are apparently the result of aqueous and atmospheric agencies. The proofs of such an upper limit to the glacier may be given in the following order:

1. Above it the outcropping rocks are more abrupt and precipitous, even on the north slopes, and there are no marks of any abrading or polishing agent. No *roches moutonnées* have been discovered on these higher peaks and slopes.

2. The outcrops and the surface on these summits and higher slopes are made up either of angular, sharp-edged rocks in place, or the slightly worn blocks and rock fragments and earth of the same nature as the ledges, and apparently derived from them. Much of this material seems to have been broken off by the action of frost. Had a glacier moved over these mountain tops it would have removed this débris, or rounded the stones and more prominent ledges.

3. There is a general absence of drift earth and of stones foreign to the rocks *in situ*. There do not appear to be any erratics nor mixed earths. A glacier would have left some foreign materials to mark its course.

4. The phenomena on these higher peaks correspond with what are so common and so characteristic of the country lying south of the terminal moraine. No glacialist can avoid noting this resemblance. If the latter is unglaciated, the former must be also.

The only explanation left is that there was a limit to the ice sheet, above which it did not go. It was not thick enough to cover all of these peaks.

The following table gives the elevations of glacial drift or markings. The heights were determined by barometric observations, viz:

On Black Dome	2940	feet.
North Mountain	2500	"
Indian Head, or Round Top	2800	"
Overlook Mountain (striæ)	3000	"
High Peak (old Round Top)	3250	"
Hunter Mountain	2800	"
Wittemberg Mountain	2900	"
Slide Mountain	3080	"
Mt. Pisgah (west of Margaretville)	2930	"
Ontiora	3300	"
Utsyanthia	3200	"

These heights are the upper limits to which glacial phenomena could be traced with certainty. No doubt more careful explorations, by uncovering the rock, would discover some markings at greater heights. We have given what has appeared to be the general horizon. Local variations, even within narrow limits, would be expected. It should also be borne in mind that the existence of the great glacier, filling all the lower valleys, and overtopping many of the peaks of the Catskills necessitated a degree of cold and other conditions which favored the accumulations of snows on these higher peaks, analogous to the snow coverings of all mountain peaks above the snow line. And in some cases they may have amounted

to incipient glaciers, whose melting did much to mix materials and round off ledges and bowlders or loose blocks. The rounded ledges of some localities above the horizon given above, and the slightly rounded rock fragments found near them, may have had their origin in some such way.

The direction of the striæ and the grooves are omitted, as not pertinent to the question. Suffice it to say here that they indicate a general southwest movement.

That such an upper limit of the glacier was probable has been indicated repeatedly by Professor James D. Dana in his Manual of Geology and in articles in this Journal. In one of these latter, on the Mohawk Valley Glacier, he says: "On the Catskills the glacier scratches reach to a height of 2235 feet—the elevation at the Mountain House—and this implies the existence of ice and snow to a height of at least 2600 feet; and if the snow had this height over the whole southern plateau it would have almost completely buried it, with the exception of the higher Catskill summits."* This language seems almost prophetic. But the ice reached higher than Professor Dana at that time supposed, though still not high enough to bury the higher summits.

The only mountains in New England which approach the height of the Catskills, and are in the same latitude, are Mt. Everett in Massachusetts and Greylock, in the same State, but little farther to the north. Of the first-named, Professor Dana says that its glaciated summit "affords evidence that the ice which covered New England in the Glacial Period overtopped this mountain, and had an elevation in that region not much under 3000 feet. Similar facts in the White Mountains place the height there at not less than 5800 feet. Calculating the slope of the upper surface of the glacier over New England from these data, it follows that the height above the region of New Haven, in southern Connecticut, may have exceeded 2000 feet, and could hardly have been less than 1500."†

Mt. Everett is due east from Overlook Mountain (of the Catskill group) and is eighty-eight miles north of the terminal moraine on Long Island. From the Slide and Wittemberg Mountains to the same moraine—at Perth Amboy—the distance is 108 miles. These figures give a descent to the glacier surface of less than thirty feet to the mile, and less than one-half of a degree. But this rate corresponds closely with that obtained by Professor Geikie for the Scottish Glacier, viz: 1 in 211.

From what is known of the Greenland glacier and the great Antarctic ice-cap we should infer that the inclination of the

* This Journal, II, vol. xxxv, p. 249.
† This Journal, III, vol. x, p. 168.

continental ice-sheet of the glacial epoch was not uniform The rise was probably steep near the margin. And the high glaciated points near the line of the terminal moraine indicate that such was the fact. Thus, near Feltville and Summit, the drift-covered Springfield Mountain, which is about a mile north of the line, is nearly 600 feet high.

The high drift-hills near Mount Hope (960 feet) show a great thickness near the margin. The height of Schooleys Mountain drift has been referred to, and the thickness of the ice in the Musconetcong Valley. Northward the angle of the slope diminished and the glacier surface approximated to a great level plain. The distance between the high, southwestern peaks of the Catskills, and Pocono Knob in Pennsylvania, is sixty miles. The difference in the elevation of the glacier could not have exceeded 1000 feet. In that direction the slope was less than on a meridian line from the Catskills, southward. Going north, the highest peaks of the Adirondacks are 150 miles distant from the Catskills, and the Green Mountains are quite as far away in the north-northeast. Assuming that the rise was fifteen feet per mile only, it would have been enough to have overtopped Mt. Marcy and Mt. Mansfield, and, of course, all the lower peaks in these groups of mountains. The explorations of Professor Charles H. Hitchcock show that even the White Mountains were submerged by the ice of the glacier. So that we have no outstanding peaks farther north. The great glacier appears to have covered the whole of New England and northern New York, and to have filled the Hudson Valley to a depth of at least 3000 feet, as far south as the Catskills, burying the Berkshire Hills, the Shawangunk Mountain range, and the Highlands of southern New York, in its icy folds. Above it stood the higher peaks of the Catskills and the summits of the Moosic Highlands as isolated landmarks—or islands in the great *Mer de Glace.*

ART. XXXV.—*Contributions to the Geological Chemistry of Yellowstone National Park.*

Geyser Waters and Deposits.

THE following include all the specimens analyzed which are not distinctly siliceous.

1. *Mammoth Hot Springs, Old 9th Terrace Spring.*

	Grams to Imp. gallon.
Sodium sulphate	34·44
Sodium chloride	18·90
Calcium carbonate	17·92
Magnesium carbonate	8·68
Silica	3·36
	83·30

2. *Deposit from Mammoth Hot Springs.*—This was in white masses evidently incrustations. The structure was distinctly radiated. It was soluble in hydrochloric acid with effervescence, leaving only a trace of residue.

Calcium carbonate	96·80
Magnesium carbonate	1·36
Alumina and iron oxide	0·45
Silica	0·25
Water	0·50
	99·36

3. *Cleopatra Spring.*

	Grams to Imp. gallon.
Sodium sulphate	35·504
Sodium chloride	13·496
Calcium sulphate	13·587
Calcium carbonate	24·850
Magnesium carbonate	7·455
Silica	3·500
	98·392

Rocks of the Park; by WILLIAM BEAM.

3. *Rock from Yellowstone Cañon near Falls.*—Consists of white, opaque fragments, rough to the touch. Fracture conchoidal, texture porous. Hardness, 3·5; sp. gr., 2·36; fusibility, 5·5. Gives a colorless bead with microcosmic salt and borax; moistened with cobalt nitrate and heated, it turns bright blue. Hydrochloric acid dissolves 14·6 per cent of the powdered mineral. Analyses gave:

SiO_2	64·60
Al_2O_3 and Fe_2O_3	25·65
MgO, CaO	traces
K_2O	·76
Na_2O	·43
H_2O	8·70
	100·14

The rock has the appearance and qualities of a very compact or baked clay; it adheres strongly to the tongue; when breathed upon has a distinct pipe-clay odor, and the powder becomes plastic with water. Not being familiar with this region, I am unable to give a full explanation of the character of this rock; but I incline to the view that it is a clay metamorphosed by proximity to a dyke or lava stream. The specimens examined may have been taken at some distance from the source of heat, as it seems difficult to suppose that a clay would retain its plasticity after having been heated to the degree which immediate contact with the melted rock would cause.

4. *Trachyte from Junction Valley.*—The pieces were greenish-blue, interspersed with white and dark spots and small particles of free silica. Fracture uneven. Hardness, 4·5; sp. gr., 2·84; fusibility, 5·5. Gives reaction with borax for iron. Heated with cobalt nitrate, the whole parts become blue and the rest brown. Composition:

SiO_2	69·90
Al_2O_3	17·58
Fe_2O_3	2·41
CaO, MgO	traces
K_2O	4·16
Na_2O	2·41
H_2O by ign.	3·65
	100·11

ART. XXXVI.—*Notes on American Earthquakes:* No. 12. By Professor C. G. ROCKWOOD, Jr., Ph.D., Princeton, N. J.

THIS article embodies such information as the author has obtained in regard to the earthquakes which occurred on the American continent and adjacent islands during the year 1882, with notice of some earlier ones not before reported here.

Items which depend on single sources of information usually have their source indicated; and if regarded as doubtful, are printed in smaller type.

For assistance in collecting information the author is again indebted to J. M. Batchelder, Esq., of Boston; to Professor F. E. Nipher, of the Missouri Weather Service; to Dr. J. W. Dawson, of Montreal; to Charles Carpmael, of the Meteorological Service of Toronto; and especially to Mr. Edwin Rockstroh, of the Ynstituto Nacional, at Guatemala, to whose kindness are due the unusually full reports from that region.

The Monthly Weather Review of the U. S. Signal Service has also furnished much valuable information.

1879.

June 8.—10.51 A. M. An earthquake occurred at San José de Costa Rica.

June 19.—3.00 A. M. A slight shock at Guatemala.

Sept. 21.—11.13 A. M. A weak shock at San José de Costa Rica.

Oct. 11.—12.45 A. M. A slight shock at Guatemala.

Nov. 18.—10.40 A. M. A weak shock at San José de Costa Rica.

Dec. 29.—7.43 P. M. A somewhat strong earthquake at San José de Costa Rica.

1880.

Jan. 11.—8.42 P. M. A slight shock at Guatemala.

The following were all at San José de Costa Rica.

Jan. 7 and 26. Weak shocks.

Mar. 3.—9.50 A. M. A weak shock.

Mar. 17.—10.32 A. M. A strong shock.

May 15.—8.31 P. M. A light shock.

May 22.—6.17 P. M. A light shock.

May 25.—2.58 A. M. A strong shock of seven or eight seconds' duration.

July 13.—7.30 P. M. A weak shock.

Dec. 30.—10.04 P. M. An earthquake of three seconds' duration.

1881.

Jan. 23.—5.30 A. M. A moderate shock at Guatemala; reported also (5.55 A. M.) at San José de Costa Rica.

Mar. 3. During the night of the 2d and 3d several slight shocks were felt at San Marcos, a town northwest from Guatemala.

Mar. 7.—7.52 A. M. A slight shock, lasting three seconds, reported from Dos Caminos, Mexico.

Mar. 15.—1.50 P. M. A moderate shock lasting four seconds at the same place.

Mar. 29. A moderate shock (N. to S.), reported from Oaxaca (12.50 P. M.), and Tlacolula (12.55 P. M.).

Mar. 30. Slight shocks reported at Villa Juarez Ixtlan (12.55 A. M., N. to S., 5 sec.), and at San Carlos Yautepec (1.30 P. M., E. to W., 4 to 6 seconds.).

The last four items are by E. R., from a Mexican paper.

April 6. A heavy shock reported from San Salvador, Central America.

April 16 to 22. More than fifteen moderate shocks, all vertical, reported from San Salvador during these six days.

April 27.—10.20 A. M. and 11.30 A. M., moderate shocks at Guatemala.

April 28. At 9 P. M. a violent shock with vertical movement, lasting more than fifty seconds, did some damage at Managua, in western Nicaragua, and was followed by other shocks at 10.00, 11.00 and 11.30 P. M. The first shock was also reported as very heavy at San Juan del Sur and Chinandega, and was felt at various points between these places.

May 13.—5.30 P. M. A slight shock, S. to N., duration three seconds, at San Carlos Yautepec, Mexico.

May 27.—12.15 P. M. A slight shock, duration three seconds, at Oaxaca, Villa Juarez Ixtlan, and San Carlos Yautepec (S. to N.), Mexico, and also at San Cristobal las Casas (1 P. M., E. to W.).

May 29.—1.40 P. M. A slight shock at Guatemala.

Aug. 13.—12.30 P. M. A strong earthquake at San Marcos, Guatemala; felt also slightly at the capital city.

Sept. 25.—4.20 P. M. An earthquake of about two seconds' duration at San Cristobal las Casas, (Chiapas) Mexico.

Oct. 3.—9.30 P. M. A slight shock at Acaponeta, Mexico.

Oct. 17. At 12.50 A. M. a shock of two seconds' duration at Dos Caminos, Mexico. At 1.55 P. M. a strong shock, duration three seconds, at Chilpancingo.

——— Also at Mexcala, hour not given, a strong shock of two seconds' duration, probably coincident with that last mentioned.

Oct. 19.—4.20 P. M. A strong shock at Tehuantepec, Mexico, duration six seconds.

Oct. 20.—2.58 P. M. Another shock at same place, duration four seconds; reported also at Juchitan, with direction E. to W.

Oct. 21.—At 8.05 P. M. a shock, E. to W., duration three seconds at Tlacolula, Mexico.

——— At 9.22 P. M. and 11.30 P. M. shocks of six and two seconds, at Tehuantepec, with subterranean rumbling.

——— A shock was reported the same day from Oaxaca, hour not stated, direction E. to W., duration six seconds; very likely coincident with one of those mentioned above.

Oct. 22 to 27. Shocks were noted at Tehuantepec as follows: 22d, 4.10 A. M. (6 seconds); 8.15 P. M. (3 seconds); 9.20 P. M. (3 seconds); 11.30 P. M. (4 seconds). 23d, 1.00 A. M. (11 seconds and rumbling); 8.53 A. M. (rumbling); 9.30 A. M., 10.00 A. M., 11.38 A. M., 3.37 P. M., 7.05 P. M., 8.43 P. M., 10.00 P.M. (all 3 or 4 seconds). 27th, 10.03 A. M. (N. to S., 3 seconds).

All the above items, in 1879–81, are from Mr. E. Rockstroh, of Guatemala.

1882.

Jan. 8.—5.10 P. M. A shock of ten seconds' duration at Cape Lookout, N. C. *U. S. Weath. Rev.*

Jan. 20.—10.02 P. M. A slight shock at Guatemala. E. R.

Jan. 26. Two severe shocks in the evening at Centreville, Cal.

Feb. 3.—2.40 A. M. A sharp shock, direction apparently S. to N., at San Gorgonio, California. *U. S. Weath. Rev.*

Feb. 12.—1.30 A. M. A shock at Pagosa Springs, Lake City, and Capitol City in southwestern Colorado.

Feb. 26.—6.25 P. M. A shock, lasting three or four seconds, at Murray Bay, Quebec.

Mar. 2. At 2.48 A. M. a strong shock, lasting twenty-four seconds, was felt at Guatemala, and the neighboring places, doing some damage in Antigua. At 5.58 A. M. a less heavy shock followed, lasting seventeen seconds. The direction of these two shocks at Guatemala was S.W. to N.E. The same night five moderate shocks were reported from Salamá, a town sixty miles north from Guatemala. E. R.

Mar. 3.—7.48 A. M. A strong earthquake, from N.E. to S.W., in San José de Costa Rica; duration, forty-seven seconds. It was felt also in Puntarenas, Alajuela, Heredia and Cartago, and generally from the dividing ridge between the oceans to the Pacific coast. Light shocks followed in Puntarenas, at 11.30 P. M. of 3d and 4.30 A. M. of 4th.

The first accounts of this earthquake were greatly exaggerated, reporting a loss of several thousand lives. The real damage appears to have been very slight.

Mar. 11.—4 P. M. A slight shock, N. to S., at San Diego, California; reported also from Poway, California, at 3.30 P. M.

Mar. 16.—1.15 A. M. A strong shock at San José de Costa Rica; duration, two seconds. E. R.

Mar. 16. A shock in the morning in the City of Mexico. *N. Y. Times.*

Mar. 16.—1.46 P. M. A light shock in San Francisco, California. *U. S. Weath. Rev.*

Mar. 21.—1.30 A. M. A weak, and at 2.42 A. M. a strong, shock at San José de Costa Rica. E. R.

March. At Salinas City, California, light shocks twice during the month. *U. S. Weath. Rev.*

April 2. At Newmarket, Va., several shocks reported in the evening.

April 2. Two shocks in the morning at Amsterdam, N. Y. J. M. B.

April 11.—11 P. M. A slight shock in New Orleans, La. *N. Y. Times.*

April 13.—6.30 A. M. A sharp shock, N. to S., lasting about four seconds, in San Francisco, Cal. *U. S. Weath. Rev.*

April 17. "A few minutes past two o'clock" a sharp shock at Hopkinton, N. H. J. M. B.

April 30. At 10.48 P. M. the vicinity of Portland, Oregon, was shaken by two earthquake shocks, a few seconds apart, the first light, the second more severe, with a low rumbling; vibration in a general west-east direction. Another light shock followed at 12.25 A. M. of May 1. The heavier shock was reported as far north as Olympia, W. T., and Victoria, B. A.

May 1. An earthquake at East Greenwich, R. I. J. M. B.

May 8. About 4 A. M. a slight shock at Concord, N. H. *Concord Monitor.*

May 11.—8 P. M. A slight shock at Pagosa Springs, Col. *U. S. Weath. Rev.*

May 21.—9.37 P. M. A moderate earthquake in Guatemala. E. R.

June 8 to 10. At 11.52 P. M. of 8th, at 9.20 P. M. and 9.28 P. M. of 9th, and at 10.37 P. M. of 10th, moderate earthquakes in Guatemala. E. R.

June 27.—5.22 A. M. Two severe shocks at San Francisco and vicinity, each about ten seconds' duration, with four seconds between. They were felt along the coast from Petaluma to Hollister, and as far inland as Stockton.

July 15.—7.45 P. M. A sharp shock at San Francisco, Cal., felt slightly at Point San José.

July 19.—2.35 P. M. A very severe shock in the City of Mexico, lasting two and a half minutes. It was said to be the most severe since 1864.

July 20.—4 A. M. A shock, duration fifteen seconds, at Cairo, Ill.

July 22.—11.08 A. M. A very light shock at San Francisco, Cal. *U. S. Weath. Rev.*

July 28. A single shock, hour not stated, at Ironton, Mo.

July 31. About noon a light shock at Cape Mendocino, Cal. *U. S. Weath. Rev.*

Aug. 1.—6 P. M. A light earthquake at Point des Monts, at the mouth of the St. Lawrence River. *Canadian Meteorol. Serv.*

Aug. 8. Light shocks, S.E. to N.W., at Oakland, Cal. *U. S. Weath. Rev.*

Aug. 9.—8.45 P. M. A light shock at San Francisco, Cal. *U. S. Weath. Rev.*

Aug. 15.—10.30 A. M. A strong earthquake at Point des Monts, Quebec. *Canadian Meteorol. Serv.*

Aug. 24.—3.56 P. M. A moderate earthquake in Tecpan, Patzizia and Quezaltenango, Guatemala. E. R.

Aug. During the month two severe earthquakes and several minor shocks occurred in Caraccas, Venezuela. *H. D. Warner, in Atlantic Monthly.*

Aug. At Salinas, Cal., shocks were felt twice during the month. *U. S. Weath. Rev.*

Sept. 6. An earthquake in Aux Cayes, Hayti. *Troy (N. Y.), Daily Times.*

Sept. 7. About 3.20 A. M. (variously given from 3.15 to 3.24), the isthmus of Panama was shaken by a very severe earthquake lasting about sixty seconds. This violent shock had been preceded by rumblings, and was followed by another shock after half an hour, and by other lighter shocks during that and the succeeding days, especially at 1 P. M. and 11.30 P. M. of 7th, and about 5 A. M. of the 9th. The violent shock affected a very wide extent of country. It was felt at Panama, Aspinwall and generally throughout the isthmus and adjacent islands; at Rivas and Greytown in Nicaragua; at Guayaquil, in Ecuador; at Buenaventura and Cartagina, in Colombia; at Maracaibo and Caraccas in Venezuela; that is, along the whole northwestern coast of South America. At Panama the Cathedral and other public buildings were partly overthrown and fifty or sixty houses were injured. The damage was estimated at $250,000. Two lives were lost by falling walls. The railroad between Aspinwall and Panama was injured in many places by the sinking of the road-bed and the breaking of culverts, and the telegraph cable from Aspinwall to Jamaica was broken by the shocks about fifty miles from the isthmus. At Caraccas, where the most violent shock occurred at 2.20 A. M., the loss amounted to eight persons killed, twenty-six wounded, sixty-two buildings totally destroyed and sixty-seven others badly cracked.

Sept. 13. In the evening a slight shock reported in Caledonia, Livingston County, N. Y.

Sept. 19.—4.17 P. M. A moderate earthquake in Guatemala. E. R.

Sept. 20. At noon a light earthquake at Point des Monts, Quebec. *Canadian Meteorol. Serv.*

Sept. 27. At 4.20 A. M. (St. Louis, Mo., time), a somewhat severe earthquake was felt throughout southern Illinois. Its influence extended west and east, from Mexico, Mo., to Washington, Ind., and Henderson, Ky.; and north and south from Springfield, Ill., to Pinckneyville, Ill., being reported from numerous places within these limits. The area affected would therefore be an ellipse, measuring 250 miles east and west by 160 miles north and south. From many places round about this area and in its borders came the report that *no* shock was felt, so that its boundary is pretty well defined. The time stated above is based upon several closely accordant and trustworthy observations in and near St. Louis. The reports from other persons varied all the way from 2.15 A. M. to 5.05 A. M. The reports of direction were equally various, but on the whole point to a general east-west motion which is also indicated by the form of the district affected. In very many places more than one shock was reported, the number being variously given from two to twelve. In almost all places subterranean rumbling was heard, but a few places, as Whitehall, Ill., and Louisiana, Mo., distinctly reported that *no* sound was heard. The motion was sufficient to crack chimneys, overthrow small objects, as toilet bottles, and set pictures vibrating. This summary is based on reports from over fifty different places, for many of which I am especially indebted to Professor F. E. Nipher.

Sept. 30.—10.57 A. M. A sharp shock at Campo, Cal., lasting two seconds; direction S.E. to N.W. *U. S. Weath. Rev.*

Oct. 8. At 2.00 A. M. a heavy shock, lasting several seconds, at San Diego, Cal.; felt generally in the surrounding country.

Oct. 8.—5.00 A. M. A sharp shock at Antigua, W. I. *N. Y. Times.*

Oct. 9. News of this date from Cape Haytien, W. I., says: "Three slight shocks of earthquake were felt here during the past week."

Oct. 10.—4.15 A. M. A slight shock at Montreal; felt also at Lachine, St. Hiliare, Huntingdon and other points near.

Oct. 11.—11.15 P. M. A slight shock at Panama.

Oct. 12. "An earthquake shock is reported to have been felt in the southern part of Humboldt Co., Nev." *U. S. Weath. Rev.*

Oct. 13.—4 P. M. Two sharp shocks at St. Thomas, W. I.

Oct. 14–15. About midnight southern Illinois again felt several shocks of earthquake similar to that of Sept. 27th but feebler. The district affected was from St. Louis and St. Charles, Mo., east and northeast to Springfield and Decatur, Ill. It was also reported at Indianapolis, Ind. There appear to have been at least three distinct shocks, the first at 11.49 P. M., St. Louis time (reported at Collinsville, 11.50½ P. M.); another between 12 and 1 A. M., and a third between

4 and 5 A. M. At Manchester, Scott Co., Ill., the times were given as 12.33 A. M. and 4.35 A. M. Most observers reported only two of the three shocks, some the first two and others the last two. Centralia, Ill., was the only place where all three were reported.

Oct. 15. At 12.30 P. M. a slight shock reported at Murphy, N. C. *U. S. Weath. Rev.*

(Should *p. m.* be *a. m.*, and this be a part of the earthquake in Illinois already noted?)

Oct. 20.—1.40 A. M. A slight shock at Lima, Peru. *N. Y. Times.*

Oct. 20.—2.15 A. M. A severe shock at San Francisco, Cal., felt lightly at Point San José.

Oct. 20. At 7.30 (A. M.?), a slight shock at San Salvador, Cent. Amer. *N. Y. Times.*

Oct. 22.—At 12.10 A. M., Indianapolis time, a slight shock at Greenville, Bond Co., Ill.

Oct. 22. About 4.15 P. M. an earthquake was felt in northern Texas, western Arkansas and eastern Kansas, and presumably in the intervening portions of the Indian Territory. The region affected extended from Greenville and Paris, Tex., and Little Rock, Ark., northwesterly to Wichita and Leavenworth, Kan., a distance of some 300 miles. The shock was reported from numerous places within these boundaries, and also, as a light shock, from Warrenton, Mo., which is farther eastward. The most definite report of time was from Wichita, Kan., which gave 4.19 P. M., Jefferson City, Mo., time. In many places two or three pulsations were noticed, having a duration of about thirty seconds in all. Reports of direction are too various to be classified. No damage was done other than overturning movable articles and knocking bricks from chimney-tops.

Oct. 23. About 7 P. M. a slight shock reported at Newberne, N. C. *U. S. Weath. Rev.*

Oct. 31.—6.45 P. M. A sharp shock at San Francisco, Cal., felt also at Sonoma, Napa, Petaluma and San Rafael; vibration east and west.

Nov. 7. About 6.30 P. M. an extensive earthquake was felt in Colorado, Wyoming and Utah. It was reported from Salt Lake City and all along the Union Pacific R. R. eastward to Laramie City and Cheyenne, Wyoming Ter.; from Georgetown and Louisville, Col.; from Denver, where the clocks were stopped at 6.25 P. M., and from Salina, Kansas. At some places three shocks were noticed. The direction was generally east and west, and the intensity sufficient to set chandeliers vibrating.

Nov. 14. In the morning an earthquake at Panama, felt on both sides of the isthmus.

Nov. 14. A light shock felt at St. Louis, Mo., 9.14 P. M. (9.16½ P. M., by B. D. Kribben); at St. Charles, 9.21 P. M., and at Collinsville, Ill., 9.17½ P. M.

Nov. 27.—6.30 P. M. A severe shock occurred at Welland, Allanburg, Port Colborne and other places along the Welland Canal between Lake Erie and Lake Ontario.

Nov. 28.—5.15 P. M. A sharp shock at San Salvador, Cent. Amer.

Nov. 30. A second lighter shock at daylight at the same place. *N. Y. Tribune.*

Dec. 11. Two slight shocks at Santiago de Cuba followed by a more severe one on the morning of the 12th. *N. Y. Times.*

Dec. 19. About 5.20 P. M. a shock occurred in the southeastern part of New Hampshire. It was felt at Dover (5.15 P. M.), Contoocook (5.20 P. M.), Concord (5.24 P. M.), New Market (5.25 P. M.), and other neighboring places. It lasted several seconds and was accompanied by a rumbling noise.

Dec. 19. Two slight shocks at Panama.

Dec. 19.—11.45 P. M. Two light shocks, east to west, at Visalia, Cal. *U. S. Weath. Rev.*

Dec. 31. About 10.05 P. M. a decided shock with rumbling noise was felt in Halifax, N. S. and other places along the railroad to Truro. It was also reported from Eastport (9.55 P. M.), Rockland (10.00 P. M.) and Bangor (9.30 P. M.), in Maine.

The above record for 1882 includes seventy-two items, of which thirteen are in small type. They may be classified geographically as follows:

Canada,	6	
New England,	5,	3 doubtful.
Atlantic States,	6,	4 "
Mississippi Valley,	11,	2 "
Pacific Coast,	19,	3 "
Mexico and Central America,	18	
Venezuela,	1	
West Indies,	5,	1 "
Peru,	1	
	72	13

The following may be selected as the more important of the earthquakes noticed above:

March 2, Guatemala; March 3, Costa Rica; April 30, Oregon; June 27, California; Sept. 7, Central America; Sept. 27, Illinois; Oct. 14, Illinois; Oct. 22, Arkansas, Kansas, etc.; Nov. 7, Colorado and Wyoming.

Thirty-six items are added to the record of previous years. They all refer to the Central American region, and are distributed as follows: 1879, six; 1880, nine; 1881, twenty-one.

Princeton, N. J., March 12, 1883.

ART. XXXVII.—*A Four Years' Record of Earthquakes in Japan, studied in their Relation to the Weather and Seasons;* by THOS. H. STREETS, M.D., U. S. Navy.

"FROM time immemorial it has been asserted by the natives of the countries which are most frequently ravaged by earthquakes, that these commotions bear some intimate relation to the movements of the atmosphere, and very generally coincide with certain meteorological conditions, such as rainy seasons, numerous storms, warm and damp winds."—(Reclus, Earth.) Humboldt, likewise, seemed to have been impressed with the importance of this relation. He says, "but if no meteorological phenomena indicate the coming earthquake, either on the morning of the shock or a few days previously, the influence of certain periods of the year (the vernal and autumnal equinoxes), the commencement of the rainy season in the tropics, after long drought, cannot be overlooked even though the genetic connection of meteorological processes, with those going on in the interior of our globe, is still enveloped in obscurity."—(Cosmos.)

Japan is preëminently a country of earthquakes, as the list given abundantly testifies. It was compiled from the weather statistics kept at the United States Naval Hospital at Yokohama, Japan, which is a station for taking international meteorological observations. The list includes every shock, that could be appreciated without the aid of a seismometer, that occurred in a period of four years, beginning with 1878; and, counting only those that were separated by a lapse of several hours; there were in this period 124 distinct shocks. There is no questioning the accuracy of the accompanying observations, which were carefully recorded every three hours. The height of the barometer above the sea-level is 115 feet.

In the first place I think we may conclude that the barometer gives no indication of the approach of an earthquake; but the charts would indicate that they are associated with a comparatively high state of atmospheric pressure. Between the highest and lowest barometer with which they were accompanied, there is a variation of little more than one inch, from 30·44 to 29·33; and within these limits we have them occurring under the most variable conditions of the barometer, when it was rising and when it was falling, as well as when it was steady.

At first sight it would appear as if the shocks were associated with atmospheric commotions. About 75 per cent of them preceded, or accompanied, rainy or threatening weather, or heralded clearing weather. To one unacquainted with the

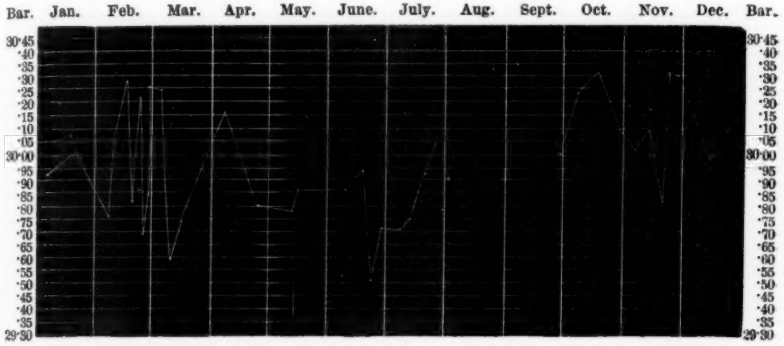
Date.	Number.	Time.	Barometer.	Sky.	Remarks.
1878					
Jan. 22	2 shocks	3.19 and 3.35 P. M.	29·91 rising	clear	
24	smart shock	3.30 P. M.	30·00 rising	clear	1·23 in. of rain on the 26th.
Feb. 5	slight shock	3.27 P. M.	29·75 falling	cloudy	Light rain and sleet.
11	shock	7.26 P. M.	30·04 steady	clearing	After 5½ in. of snow-fall.
17	3 shocks	A. M.	30·27 falling	cloudy	Light rain next day.
19	slight shock	1.16 P. M.	29·82 rising	cloudy	Midnight strong winds.
23	2 shocks	A. M.	30·21	cloudy	
24	shock	9.45 A. M.	29·69 rising	rain	
25	smart shock	10.24 P. M.	29·84 rising	clearing	
27	light shock	0.26 A. M.	30.25 rising	clear	28th, A. M., rainfall of 1·26 in.
Mar. 5	sharp shock	3.00 P. M.	30.24		Fol'w'd by rainfall of 1·17 in.
6	light shock	2.06 P. M.	29·59 falling	cloudy	Barometer rising at 3.30 P. M.
7	slight shock	10.25 P. M.	29·74 rising	clearing	Followed by 9 d. of cl'r sky.
Apr. 9	slight shock	2.45 P. M.	30·16 falling	rain	Followed by 8 days of rain [and cloudy weather.
28	slight shock	4.05 P. M.	29·80 rising	rain	
May 10	slight shock	9.10 P. M.	29·78 rising	clearing	
11	light shock	7.14 A. M.	29·86 rising	cloudy	Light rain next day.
Jun. 11	smart shock	0.15 P. M.	29·86 falling	clear	
17	smart shock	5.20 A. M.	29·94 rising	clearing	After a rainfall of 1·47 in.
22	shock	12.00 M.	29.52	clearing	Light rain in the morning.
28	smart shock	6.34 P. M.	29·72 rising	rain	Rainfall of 2·54 in.
July 5	light shock	4.39 A. M.	29·72 falling	rain	Sky clearing during day.
10	shock	0.46 A. M.	29·75 falling	cloudy	
15	smart shock	3.45 P. M.	29·93 rising	clearing	11 rainy days since the 1st.
20	light shock	8.46 P. M.	30.03 rise	clear	Strong S.W. wind during day.
Aug.					No earthquakes during this month: 19 rainy days.
Sep. 30	light shock	5.32 A. M.	30·00 falling	cloudy	18 rainy days during month.
Oct. 8	slight shock	10.48 P. M.	30·24 rising	clearing	After 2 days light rain.
9	smart shock	1.20 P. M.	falling		Followed by light rain. [rain.
17	shock	10.25 A. M.	30·31 rising		Began to fall next d.: 19th,
31	light shock	10.15 P. M.	30·10 falling	clearing	After 2½ hours of rain.
Nov. 5	light shock	0.57 P. M.	30·03 falling	rain	
10	light shock	1.47 A. M.	30·10 rising	clear	P. M. of 11th, a heavy rain.
22	severe shock	11.12 P. M.	29·83	clear	Light rain in the morning.
26	smart shock	8.24 P. M.	30·31	cloudy	Raining at midnight.
27	light shock	2.13 A. M.	30·30 falling	rain	16 rainy days during month.
Dec. 14	smart shock	10.37 A. M.	29·99 falling	cloudy	Light rain in the morning.
24	smart shock	7.55 A. M.	30·10	rain	Barometer falling P. M.
1879					
Jan. 3	shock	9.58 P. M.	30·13 rising	clear	
21	shock	3.40 A. M.	30·28 rising	clear	Barometer falling next day, [with rain.
23	light shock	1.45 A. M.	29·80 falling	rain	
26	light shock	4.00 P. M.	30·18 rising	cloudy	
27	smart shock	A. M.	30·25 falling	cloudy	Followed by rain.
28	light shock	1.00 A. M.	29·92 falling	rain	
Feb. 2	smart shock	10.00 P. M.	30·12 falling	clearing	After a light rain in morning.
4	shock	11.00 P. M.	30·14 rising	cloudy	Rain and sleet on the 6th.
27	smart shock	2.45 P. M.	30·34 steady	clear	Barometer falling next A. M.
Mar. 4	heavy shock	4.44 P. M.	29·72		
4	shock	7.00 P. M.	29·74	rain	Rain fell from 1st to 6th.
10	shock	4.35 P. M.	29·76 falling	rain	
10	2 shocks	9.32 and 9.45 P. M.	29·75 rising	clearing	
Apr. 14	light shock	9.20 A. M.	30·14 falling	cloudy	Heavy rain next day.

Date.	Number.	Time.	Barometer.	Sky.	Remarks.
1879					
May 2	2 shocks	2.45 and 2.50 A. M.	30·10 falling	cloudy	Light rain next day P. M.
20	shock	11.28 P. M.	29·92	rain	23 rainy days during month.
Jun. 12	light shock	9.24 A. M.	29·70 falling	rain	17 rainy days during month.
July 18	2 shocks	3.45 P. M.	30·01 falling	clear	Remained clear for 10 days.
24	shock	8.15 P. M.	29·88 steady	clear	[at 9.30 P. M.
Aug. 6	smart shock	8.27 P. M.	29·83 falling		Thunder, lightning and rain
28	light shock	8.36 P. M.	29·93 falling	cloudy	Rainfall for month, ·92 in.
Sept.					No earthquakes: 11 rainy
Oct. 17	2 shocks	1.30 and 2.17 P. M.	30·17 rising	clear	[days. [on the 20th.
18	severe shock	1.52 P. M.	30·33 falling		Light rain next day; heavy
25	light shock	0.40 A. M.	30·00 falling	cloudy	Rain next day.
30	light shock	9.44 A. M	30·05 steady	clear	13 rainy days during month.
Nov 15	2 shocks	9.39 and 9.40 A. M.	30·08 rising	cloudy	Clearing on the 16th.
Dec. 3	severe shock	7.09 A. M.	29·96		Light rain next day.
1880					
Jan. 6	light shock	4.28 P. M.	29·74 rising	clear	Clear until 21st, and 3 days
19	light shock	1.00 A. M.	30·03 falling		[previous.
Feb. 12	light shock	9.00 P. M.	29·82 rising	clearing	After 4 days of rain.
22	severe shock	5.03 A. M.	29·76	raining	Ceased raining shortly after.
25	light shock	6.40 P. M.	30·44		Barometer fell the next day:
Mar. 5	light shock	4.40 A. M.	30·23	clear	[27th, rain.
21	slight shock	4.39 A. M.	30·00 rise	clear	Rainfall of 1·97 in. on 20th.
29	shock	5.25 P. M.	29·99 steady	clear	Barometer fell at night; rain on 30th.
31	slight shock	11.16 A. M.	29·79 falling	rain	Rainfall of 1·46 in.
Apr. 14	smart shock	4.10 A. M.	30.32 rising		Barometer fell at night: rain.
25	light shock	11.04 A. M.	29·59 rising	clear	Light rain preceding shock.
27	smart shock	9.50 A. M.	30·08 falling	cloudy	Moderate S. W. gale next
May 14	light shock	10.00 P. M.	29·77 falling	cloudy	[day.
23	light shock	2.30 P. M.	29·76 rising	clear	Rain on the day preceding.
June 5	light shock	5.12 P. M.	29·93	cloudy	On 7th, A. M., a heavy rain.
7	light shock	9.50 P. M.	29·33 rising	clearing	
10	smart shock	1.20 P. M.	29·84 rising	cloudy	Light rain next day.
July 15	smart shock	4.00 A. M.	29·99 rising	clear	Light rain on the 14th.
19	light shock	11.55 A. M.	29·87 falling	clear	
19	smart shock	8.24 P. M.	29·83 falling	clear	Followed by 3 days of rain.
25	smart shock	2.05 P. M.	29·70 steady		Light rain at night.
Aug. 6	smart shock	9.27 A. M.	29·96	clear	
7	light shock	1.20 P. M	29·90 falling		Followed by 6 days of rain.
13	smart shock	4.50 A. M.	29·53 rising	clear	
23	3 shocks	4.26 A. M.	29·80 falling	cloudy	Str'ng S.W. gale on 25th, P. M.
30	light shock	11.16 P. M.	30·02 falling	cloudy	Rain next day.
Sept.					No earthquakes: 10 rainy d.
Oct. 2	light shock	3.11 P. M.	29·95 falling	rain	Typhoon midnight of the 3d; barometer. 28·62; force, 11
Nov. 3	smart shock	5.43 A. M.	29·90 steady	cloudy	[Beaufort scale.
10	smart shock	1.00 A. M.	29·88 rising	clear	Sky very bright.
12	smart shock	6.30 P. M.	30·20 falling	rain	Rain continued for 2 days.
Dec. 20	smart shock	10.00 P. M.	29·90	clear	[S.W. breeze.
23	severe shock	10.57 P. M.	29·72 rising		Barometer fell P. M., with a
28	smart shock	1.30 A. M.	29·80 falling	clear	No rainy days during month.

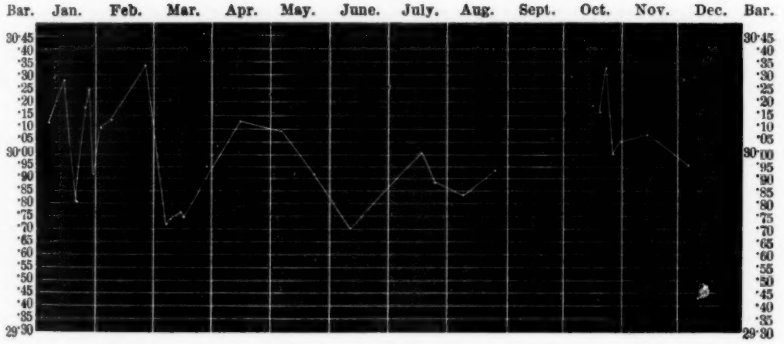
Date.	Number.	Time.	Barometer.	Sky.	Remarks.
1881					
Jan. 7	light shock	6.24 A. M	29·33 falling	clear	Barom. falling steadily since 3rd; began rising at 9 A. M.; slight snow at 3 P. M.
20	light shock	0.15 A. M.	29·46 rising		Snow on 19th, rain on 21st, fol'w'd by 2 d. cl. weather.
24	smart shock	5.52 A. M.	29·68 falling	clear	At 3 P. M. barometer 29·38, when it began to rise: clear throughout.
24	shock	9.30 A. M.	falling	clear	
27	light shock	4.00 P. M.	rising	clear	
Feb. 7	light shock	4.00 P. M.	falling	clear	
12	smart shock	2.40 A. M.	rising	clear	Rainfall of ·50 in. on 14th; also rained on the 11th.
12	light shock	2.00 P. M.	rising	clear	
28	smart shock	3.14 P. M.	30·13 falling	cloudy	Slight rain next day.
Mar. 8	severe shock	0.17 P. M.	30·34 falling	snow	4·50 in. fell from noon to midnight.
14	light shock	4.15 A. M.	29·80 falling	rain	Fresh wind and heavy rain.
15	light shock	0.26 P. M.	rising		
16	light shock	6.00 A. M.	29·96 rising	clear	
16	light shock	3.00 P. M.	30·01 rising	clear	
17	light shock	2.40 A. M.			
17	heavy shock	4.50 A. M.	30.13	clear	
29	light shock	11.20 P. M.	29·88 steady	clear	Fresh wind next day.
Apr. 11	light shock	10.00 A. M.	30·13 falling		Followed by 3 d. light rain.
18	smart shock	8.00 A. M.	29·59 rising		Followed by clear weather; 1·32 in. rain on the 17th.
26	shock	8.27 P. M.	30·03 falling		Strong S.W. winds, squally, and light rain throughout the month.
May 3	light shock	2.13 A. M.	29·90 rising	cloudy	From 1st to 7th cloudy, with light rain; on 7th a heavy S.W. gale, P. M. clearing.
24	smart shock	1.20 P. M.	rising	cloudy	Only 1 clear d. during month.
Jun. 18	smart shock	10.27 A. M.	29.80 steady	rain	3·30 in. fell to 4 P. M.
July 20	light shock	3.30 P. M.	29·85 steady	clearing	18th and 19th being rainy.
25	shock	11.35 P. M.	29·93 steady	clearing	
Aug.					No earthquakes during the month.
Sept. 3	light shock	10.30 A. M.	steady	clear	From 20th to 30th raining every day; total rainfall for the month, 11·99 in.
Oct. 25	light shock	9.25 P. M.	30·16 falling	rain	
Nov.					No earthquakes this month; total rainfall, 8·50 in.
Dec. 29	light shock	1.00 A. M.	29·96 falling	clear	
31	2 shocks	0.25 P. M.	falling	clear	Clear on the 30th and remained so for several days after the 31st.

CHARTS SHOWING THE RELATION BETWEEN THE HEIGHT OF THE BAROMETER AND EARTHQUAKES. THAT FOR 1881, BEING IMPERFECT, IS OMITTED.

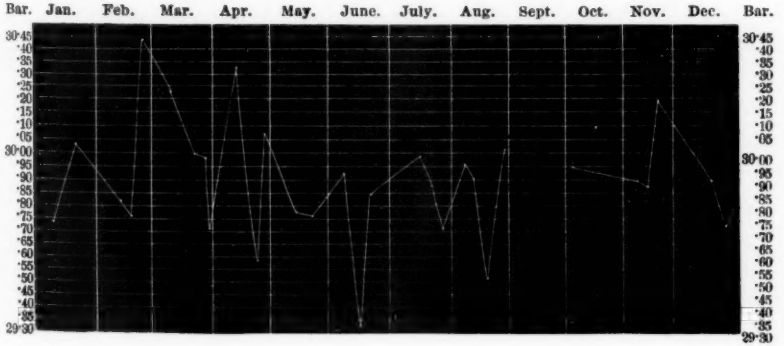
1878.



1879.



1880.



climate of Japan this might imply some relation; but I am inclined to believe that the connection is only incidental. This climate is remarkable for its humidity. In March, 1881, there were nine shocks, and but two of them were associated with any noticeable meteorological disturbance; six were accompanied by remarkably fine weather. On the other hand, in April and May of the same year, we have it recorded of the former that there were light rains throughout the month, and three shocks, and of the latter that there were two shocks and but one clear day. Again, in December, 1880, there were three shocks, two of which are set down as smart, and one as severe, and the month presents no rainy days; and in December, 1881, the two shocks that occurred were associated with fine weather. On the other hand, August and September are remarkable for their excessive humidity. They have the greatest average rainfall, and are accompanied with violent atmospheric commotions; they are likewise periods of earthquake calms. Other inconsistencies might be picked out, but the above will suffice.

"In 1834, Professor Merian, having classed according to their appearance in the various seasons of the year 118 earthquakes which occurred at Basle, and the countries around it, ascertained, to the surprise of the scientific world, that these phenomena are much more frequent in winter than in summer."—(Reclus.) The same results are obtained in the present analysis. They are here arranged as they occurred in the months and seasons:

Dec. 8		Mar. 18		June 9		Sep. 2	
Jan. 15	41 winter.	Apr. 9	35 spring.	July 11	27 summer.	Oct. 10	21 autumn.
Feb. 18		May 8		Aug. 7		Nov. 9	

A gradual decline is noticed running through the seasons. If December be omitted, and March substituted as a winter month, a more remarkable contrast is observed. We should then have 51, or 41 per cent, of the whole number of earthquakes occurring in those three months. February and March are the months of the greatest earthquake activity.

Professor Cleveland Abbé believes that the greater prevalence of the shocks in winter than in summer is dependent on climatological considerations. He says: "If it were an annual period independent of wet and dry climatological seasons, before alluded to, it would be of deep import."—(Earthquake, Appleton's Cyclopedia.) In August, 1878, there were 19 rainy days and a rainfall of 6·62 inches; in September, of the same year, there were 18 rainy days and a rainfall of 17·97 inches, and but one shock occurred, on the 30th of the latter month. In 1879, September had a rainfall of 5·80 inches and

11 rainy days; in August, of the same year, when there were two shocks, there was a rainfall of but ·92 inch. In September, 1880, there were 12 rainy days and a rainfall of 4·67 inches, and no earthquakes; in 1881 there was a light shock on the 3d of the same month, and a rainfall of 11·99 inches. It rained continuously from the 20th to the 30th, but no more shocks occurred until October 25th. March is likewise a wet month, but the amount of rainfall is less than in September. In volcanic regions the rain is thought to supply steam, which may generate an earthquake.

A period of earthquake calm is noticed in either August or September, or the season of the autumnal equinox. During the four years there occurred in the months of August, September and October, 19 shocks, and more than one-half of these are accredited to October. But two shocks occurred in September during the same period, and in the years in which these occurred the period of calm was in August. The most important conclusion arrived at in the present consideration I believe to be this: namely, that the period of earthquake calm is the period of the greatest cyclonic activity. "In Japan, the true typhoon season is restricted to August and September." —(Nature, Oct. 26, 1882, 626.) The barometer shows a similar antagonism between earthquakes and typhoons; the one is associated with a moderately high atmospheric pressure, while the other always accompanies a very low barometer. The northeast monsoon blows from October to April, and the southwest from April to October. Japan is within the influence of these winds. "The transition from one monsoon to another is a critical period, and is always heralded by variable winds succeeded by intervals of calms, and by furious tempests and whirlwinds, proving a general disturbance of the atmosphere."—(Guyot, Earth and Man.) This is more marked in the autumnal than in the vernal equinox. There appears, therefore, to be an even balance between the time of the autumnal equinox and the time of the greatest frequency of earthquake shocks, the one occurring in August and September and the other in February and March, being separated by a period of four months either way. I am aware that this conclusion differs from the opinion usually held, which is, that earthquakes are associated with the equinoctial period of atmospheric disturbance.

There occurred two shocks sufficiently severe to do damage to property, and both of these were in winter, one in December and the other in February. The latter was the heaviest shock that the country has experienced since 1850. No diurnal period is observed, though such a period has been stated by some to exist.

ART. XXXVIII.—*Observations on the fossils of the Metamorphic rocks of Bernardston, Mass.;* by R. P. WHITFIELD.

I HAVE received from Professor J. D. Dana, and from Professors Emerson and Clark, of Amherst and Northampton, Mass., collections of fossils from metamorphic sandy shales at Bernardston, Mass., and also some from a bed of crystalline limestone below them, with a request to examine them with a view to determining their age.

In the shales I find many casts and impressions of Brachiopods, of some of which the generic relations can be determined. Among them I recognize *Strophomena rhomboidalis*, a *Spirifera* (quite abundant), resembling in most of its features *Sp. disjuncta* as it occurs in the Chemung group of New York, but not showing any plications on any of the internal casts, though impressions of a shell having plications of about the same size and form have been detected in several instances among Professor Clark's specimens; two *Rhynchonellas* (common), their relations not determined, although some three or four impressions of one of the species strongly remind one of *R. neglecta* Hall; casts of a *Terebratuloid* shell, resembling very strongly those of the ventral valve of *Cryptonella eudora*, and also a single ventral cast of a *Cyrtina* closely resembling *C. Hamiltonensis*, from the Hamilton and Chemung groups of New York. Besides these there are numbers of undetermined forms, some of which might be classed with *Meristella*, but are extremely uncertain. There is also a cast of a species of *Petraia* or *Streptelasma*, which might represent equally well the species from the Niagara, Lower Helderberg and Hamilton groups.

From the limestone I recognize two species of *Favosites*, and several stems of Crinoids of large size; also from specimens sent to the American Museum of Natural History, by Professor C. H. Hitchcock, a form strongly resembling a species of *Syringopora*, but somewhat doubtful.

The *Favosites* are not in a condition to be identified specifically with certainty. One of them, however, has many characters resembling *F. favosa*, and forms a mass about four inches in diameter by about two in height. The other form is parasitic around a large crinoid stem, and has cells of about the size and form of *Astrocerium venustum* Hall; yet I cannot distinguish in it the peculiar features of that genus.

From the evidence furnished by these specimens I should conclude that the limestones may be of Middle Silurian age, and that the shales were most probably of Middle Devonian

age, the forms mostly resembling those from the New York Chemung group.

In the spring of 1882 we received at the museum a collection of rocks and fossils from near Littleton, N. H., sent by Professor C. H. Hitchcock, who has kindly permitted me to use the evidence furnished by them in this connection. Among them I recognize the corals *Halysites catenulata* and *Favosites Niagarensis*, also a finer form of Favosites which I identified, with but little doubt, with *Astrocerium venustum* Hall, and an undetermined Cyathophylloid coral. There are also many fragments of a *Pentamerus*, which I identified without question with *P. nysius* H. & W. (24th Rept. State Mus. N. Y., p. 184 and pl. x, fig. 1–7 of 27th Rept. State Mus.), a type of *Pentamerus* which ranges from the Clinton to the Guelph limestones, but which is not known above the latter horizon. From this assemblage of fossils there can be no doubt of the Middle Silurian age of these Littleton limestones (probably Niagara); and as they were supposed, from stratigraphical evidence alone, to be the same as the Bernardston limestones before the fossils were examined, I think these are strong reasons for not only making them equivalents, but also for considering both as of the age which I have assigned to them.

Note by J. D. Dana.—The "shale" referred to by Mr. Whitfield is a laminated part of the quartzite which immediately overlies the limestone, and occurs only along the junction, and locally so; the specimens are rusted from oxydized pyrite, and cavernous from the removal *probably* of calcareous material; and in the removal the laminated structure has become apparent. The calcareous material I have attributed to a passage of the limestone in places into the quartzite, the two being, to all appearance, directly consecutive formations. Since the publication of my last paper on this subject, the region has been thoroughly studied by Professor B. K. Emerson of Amherst, and before long he will publish his very important results, and give his final conclusions on the stratigraphical point suggested by the fossils,—which, though very poorly preserved, have great interest on account of the large variety of micaceous, hornblendic, gneissic and other metamorphic rocks occurring in the same series with the beds containing them. Mr. Whitfield's examinations correct my inference as to one of the Brachiopods. Professor Emerson hopes to make further discoveries, that will remove the doubts which still exist, and bring together chronologically the associated strata.

ART. XXXIX.—*Review of DeCandolle's Origin of Cultivated Plants; with Annotations upon certain American Species;* by ASA GRAY and J. HAMMOND TRUMBULL.

PART II.

THE fourth chapter of "*L' Origine des Plantes Cultivées*" relates to plants cultivated for their fruits; the fifth to those cultivated for their seeds. Our present annotations concern a few species or forms of *Cucurbitaceæ*, the history of which has been involved in some obscurity and confusion.

A word, in passing, upon the Peach, upon the history of which this volume throws some new light. DeCandolle had formerly suggested China as its home, and he has brought together additional evidence in favor of that view. He shows how this conclusion goes against an old idea that the Peach is a derivative of the Almond, which is indigenous to western Asia, and was unknown to the Chinese anterior to the Christian era, while they had peaches of various sorts long before. Upon *Pyrus*, there is a note relating to botanical orthography, p. 183, which we append, as it has an application to a few other words.*

Lagenaria vulgaris. Bottle Gourd.—Although doubtless an Old-World plant (DeCandolle attributes it to India, Molucca, Abyssinia), yet it is not quite certain that it had not reached the New World before Columbus. At least the following notes may be put upon record.

M. DeCandolle mentions the case of the name *gourd* for *pumpkin* ("potiron") by English writers, as "an example of the confusion of popular names and the greater precision of scientific names." Such confusion becomes more perplexing when we have to deal with popular names of the 15th and 16th centuries. Parkinson—a good observer and a respectable botanist—complained, in 1640, of "our modern writers who confound *Pepo*, *Melopepo* and *Cucurbita*, so promiscuously that it is not possible to find out the distinct certaintie of them all; for some make that *Pepo* that others call *Melopepo*, and others, *Cucurbita*." (*Theater of Plants*, p. 770.) Scientific names of the 16th century are as obsolete as popular names of the same period. They do not help us to distingush *Lagenaria* from *Cucurbita*, or *Pepo* from *Melopepo;* or "Citrouille" from *Citrul-*

* "L'Orthographe *Pyrus*, adopté par Linné, se trouve dans Pline. *Historia*. ed. 1631, p. 301. Quelques botanistes ont voulu raffiner en écrivant *Pirus*, et il en result, pour une recherche dans un livre moderne, il faut consulter l'index dans deux endroits, ou risquer de croire que les Poiriers ne sont pas dans l'ouvrage. En tous cas le nom des anciens est un nom vulgaire, mais le nom vraiment botanique est celui de Linné, fondateur de la nomenclature adoptée, et Linné a ecrit *Pyrus*."

Pears and Apples were prehistoric in Europe, both wild and cultivated.

lus. Early voyagers to America wrote *cucurbita*, *calabaça*, *courge* or *zucca*, as a name for any 'gourd' or pumpkin, and occasionally for a 'calabash' which was not even a cucurbit. The relation of the first voyage of Columbus repeatedly mentions the *calabazas* used by the natives of St. Domingo and other islands for carrying water (Navarrete, *Collec.* i, 180, 188), and, Dec. 3, 1492, Columbus saw, near the east end of Cuba, fields planted with *calabazas* and other productions of the country (*id.* p. 225). Yet we know from Peter Martyr that some of the gourds ("cucurbitæ") used in the islands grew on "cucurbiteas *arbores*" as tall as elms (*Dec.* i, lib. 3, and iii, lib. 4; pp. 38, 246). This tree, *Crescentia cujete*, is described by Oviedo (*Hist. gén.*, lib. viii, c. 4) under its Haytian name, *Higuëro*; in Nicaragua, it was called *Guacal;* and in Brazil, *Cuiete** (Marcgrav, *Hist. Nat. Brasil.*, 123). J. de Lery (*Hist. Navig. in Brasil.*, 154) describes the tree under the Brazilian name of *Choyne;* but elsewhere (p. 246) he says "the natives have *cucurbitæ* (*courges*) and other kinds of fruits," from which "they make their bowls, called *coui*, and other vessels."

It is certain that *calabaças* which were *not* arboreal, but genuine cucurbits, were abundant—and were believed to grow spontaneously—in the islands and on the main land, before 1526. Oviedo (*Hist. gen. y Nat.*, lib. vii, c. 8) observes that "*calabaças*, in the Indias, were as common as in Spain, and of the same kinds (de las mismas), long and round, or banded (ceñidas), and of all the shapes they usually have [in Spain]." They were much used, "in all parts of these Indias, both the Islands and the Main," and "are one of the common things that the Indians cultivate in their gardens." They were not cultivated for food—"for they do not eat them"—but for carrying water; "and they have other *calabaças*, that are in all respects like the aforesaid, except that they are bitter to the taste; and there are many of these that grow of themselves, without cultivation."† The same author (lib. xi, c. 1) in a list of plants introduced from Spain, names melons and cucumbers (pepinos), but *not* gourds.

The relation of the voyage of Amerigo Vespucci, 1489, in a description of the Indians of Trinidad and the coast of Paria, says that "each carried, hanging at his neck, two small dried gourds (*cucurbitas*), one containing the plant that they were accustomed to chew, the other, a certain whitish flour," etc.,

* Not *Cujete*—unless *j* has the German sound. The Tupi name is formed from *cuï* (*cou-in*, Lery) 'the shell' or hard rind of a nut or fruit (and the 'bowl' or calabash made from it) and *eté* 'good, precious.'

† M. DeCandolle, p. 198, citing this passage from Ramusio's Italian translation of Oviedo's *Historia Natural*, etc., has "*zucche*" for "*calabaças*" of the Spanish original, and takes no notice of what is said of their spontaneous growth.

and that each woman carried a *cucurbita* of water (Navarrete, iii, 252, 254).

The "Cucurbita lagenæ formâ," which Marcgrav found in Brazil, 1637–8 (*Hist. Nat. Brasiliæ*, 44), though "very probably *Lagenaria vulgaris*," yet, as M. DeCandolle observes, "does not prove that the species was in that country before the voyage of Amerigo Vespucci in 1504;" but we know from Lery, above cited, that the natives of Brazil used *cucurbitæ*, for bowls and drinking vessels, at least as early as 1557. Moreover, the richness of the Tupi vocabulary in gourd-names suggests—if it does not absolutely prove—that several varieties of Lagenaria were known to the Brazilians long before the visit of Piso and Marcgrav. The *Tesoro de la Lengua Guarani* (*o Tupi*) of Father Ruiz de Montoya was first printed in 1639. It gives for gourd (*calabaço*), the Tupi *general* name, *Ia* [which is a compound of *ŷ* 'water,' and *yá* or *á* 'fruit'], and for the varieties—among others—it names *ŷaçî* 'round gourd;' *ŷáyurumî* 'narrow-mouthed gourd;' *ŷátî* 'long-necked gourd;' *ŷáobá* 'wide-mouthed gourd;' *ŷáquatiâ* 'painted gourd;' *ŷácuîpé* 'spoon gourd' (used for making spoons); *ŷáapê* 'small gourd, used for drinking;' *ŷáquâ* 'great gourd;' *ŷácuî* 'gourd like a great dish' or bowl, etc.: not including the derivatives of *cuî*, or the *edible* "calabaças"—to be mentioned hereafter.

"Acosta, too," says M. DeCandolle, "speaks of *Calebasses* which the Peruvians used for cups or vases, but the Spanish edition of his book is of 1591, more than a hundred years after the conquest." (?) Acosta says *more* than this. After mention of the "Calebasses or Indian Pompions . . . especially those which are proper to the country" [Peru], he adds: "*There are a thousand kinds of Calebasses;* some are so deformed in their bigness that of the rind cut in the midst and cleansed, they make, as it were, baskets to put in all their meat, for their dinner. Of the lesser, they make vessels to eat and drink in," etc. (*Hist. nat. y moral de las Indias; translation, revised by Markham*, lib. iv, c. 19; p. 238).

Cucurbita maxima, C. Pepo, C. moschata. Pumpkin, Squash, etc.—In the Géographie Botanique not one of the cultivated *Cucurbitæ* is attributed to America, and a reference to Nuttall's record that the warted squash was grown by the Indians on the upper Missouri is the only mention of any aboriginal cultivation of squashes in North America. In the present volume, there is merely a reference, in this respect, to Dr. Harris's article in this Journal (xxiv, 1857), and to Mr. Trumbull's note in the Bulletin of the Torrey Club (1876), with the comment that: "Cela nous apprend seulement que les indigènes, un siècle après la découverte de la Virginie, 20 à 40 ans après la colonisation par W. Raleigh, faisaient usage de certains fruit de Cucurbitacées."

Nevertheless *Cucurbita Pepo*, upon botanical indications solely, is attributed to temperate North America in the general table, to a Mexican or Texan origin in the body of the work. This rests upon the collection by Lindheimer, in Texas, of a form of this species, "apparently indigenous." That was between thirty and forty years ago; no wild specimen has since been received from all that region (nor from any other); and it is well nigh certain that the species was commonly cultivated in all that country by the aborigines. If ever found truly indigenous, it will probably be farther south than Texas. *C. maxima* is now set down as from Guinea, on the strength of a single finding of it "apparently indigenous" on the banks of the Niger. *C. moschata* (to which Vilmorin refers the Canada crook-neck Squash) is in the list of species of completely unknown or uncertain origin.

In this state of the case, it is certainly worth while to present the evidence—gathered with much care and pains—which assures us that one or two, and perhaps all three, of these species, and many varieties, were largely cultivated throughout America, from the tropics to Canada, before the voyages of Columbus.

Allusion has already been made (under *Lagenaria*) to the difficulty of distinguishing the genera of *Cucurbitaceæ*, under the names by which they are mentioned by voyagers and explorers of the first century after the discovery of America; and the question of species is particularly difficult. Yet we find abundant evidence—especially as respects North America—(1) that, in various parts of the country, remote from each other, the cultivation of one or more species of Cucurbits by the Indians was established before those places are known to have been visited by Europeans; (2) that these species or varieties were novel to Europeans, and were regarded by botanists of the 16th and 17th centuries, as well as by the voyagers and first colonists, as natives or denizens of the region in which they were found; and (3) that they became known only under American names: one of these names (*Squash*) becoming, in popular use, generic, and two others (*Macock* and *Cushaw*) surviving, as names of varieties, into the present century.

To present this evidence, as nearly as possible in the order of time, we refer, first, to the relation of the first voyage of Columbus. Dec. 3, 1492, entering a small river [the Rio Boma], near the eastern end of the island of Cuba, he found near it a populous Indian village and saw large cultivated fields "planted with many things of the country, and *calabazas*, a glorious sight (que era gloria vella)!" See Navarrete, *Colec.*, i, 225. It is not *certain* that these *calabazas* were not bottle-gourds (*Lagenaria*), but it is, to say the least, highly improb-

able, that the enthusiasm of Columbus would have been so kindled by the promise of a harvest of little value to Europeans.

Oviedo (*Hist. gen. y nat.*, l. xi, c. 1) names among plants and seeds brought from Spain to Hispaniola, "*melones*" and "*pepinos*"—of which imported varieties were already abundant in the island before 1535; the seed of "*cogombros*" brought from Castile had not succeeded so well.

In July, 1528, Cabeça de Vaca found, near Tampa Bay, in Florida, "maize, beans and *pumpkins* in great plenty, and beginning to be fit for gathering." In 1535–6, when passing through Texas, the Indians supplied him with prickly pears and, occasionally, maize; but after crossing "a great river coming from the north"—probably the Rio Grande—he and his companions came to a region having "fine dwellings of civilization, whose inhabitants lived on beans and *pumpkins*"—and, when the season was not too dry for raising it, maize (*Relacion*, 1542; *transl. by B. Smith*, 1871).

In the summer and autumn of 1539, De Soto found the Appalachian country, in western Florida, well supplied with "maize, beans (*fésoles*) and *pumpkins* (*calabaças*);" the pumpkins of Uzachil were "better and more savoury than those of Spain;" there were "fields of maize, beans and pumpkins," not far from Tampa Bay, where he first landed from Cuba; at Pacaha, on the Mississippi the northernmost point he reached (1541), he found, again, "many pumpkins and much maize and beans;" and, still westward, at Coligoa, "beans and pumpkins were in great plenty; both were larger and better than those of Spain; the pumpkins when roasted had nearly the taste of chestnuts" (Oviedo, lib. xvii, cc. 24, 28; *True Relation, etc., by a Fidalgo of Elvas; transl. by Buckingham Smith*, pp. 45, 47, 122, 285). Oviedo writes "calabaças," but the author of the Portuguese *Relaçam Verdadeira* (1557) has, in one or more of the places cited, "*aboboras*."

In 1535, Jacques Cartier, the first explorer of the St. Lawrence, found among the Indians of Canada "grand quantité de *gros melons, concombres* and *courges*" (*Bref Recit de la Navigation*, etc., 1545; *reimpr. Tross*, 1863, ff. 24, 31).

Sagard, whose *Grand Voyage du Pays des Hurons* was made in 1642, makes repeated mention of the native squashes ("citrouilles du pays"), which the Hurons raised in abundance, and which he found very good, boiled or baked (pp. 85, 105, 140, 331). In his *Histoire du Canada* (283), he describes the method by which the Indians hastened the germination of the seeds of these "citrouilles du pays," and "raise them with great ease."

Lahontan (*Nouv. Voyages*, 1703, ii, 61) describes the *Citrouilles* of (southern) Canada—"sweet, and of a different kind from

those of Europe, where," as several persons assured him, these would not grow. "They are of the size of our melons; the flesh, yellow as saffron. They usually bake them in the oven, but they are better roasted under the embers, Indian fashion," etc. Lahontan had as little doubt as Sagard had, that these *citrouilles* (cultivated by the Indians of Canada from the time of Cartier, at least) were genuinely "du pays."

As to the Cucurbitaceæ of Virginia, M. DeCandolle admits, "only, that the natives, a century after the discovery of Virginia, twenty to forty years after the colonization by W. Raleigh, made use of certain fruits of *Cucurbitaceæ*" (p. 201). Let us reëxamine the evidence. Captains Amidas and Barlow, in the first vessels sent by Sir Walter Raleigh to the New World, landed on an island in Ocracoke Inlet (now within North Carolina) in 1584. While the vessels remained there, and while they were at Roanake Island near by, the Indians entertained them kindly, and "sent them, commonly every day, a brace of bucks, conies, etc., sometimes *Melons*, Walnuts, *Cucumbers*, Pease, and divers roots" (J. Smith's *Gen. History*, p. 3).

What these "melons," or some of them, were, we learn from later explorers and the first colonists of Virginia (proper).

Capt. John Smith says that the Indians of Virginia (1606–08) "plant amongst their corn *Pumpions*, and a fruit like unto a musk-melon, but less and worse, which they call *Macocks*," etc. (*Gen. Hist.*, p. 29). Strachey, who was in Virginia, in 1610, describes these "*macock* gourds" in nearly the same words (*Trav. into Virg.*, p. 72); elsewhere, he says the "*macokos* is of the form of our pumpions—I must confess, nothing so good,—'tis of a more waterish taste," and he mentions also, the "pumpions" planted by the Indians, and "a kind of *million*" which they "seeth, and put into their walnut-milk, and so make a kind of toothsome meat" (p. 119). "The *Indian Pumpion*, the water-melon, musk-melon," etc., are named among fruits introduced into Bermuda, by the English, before 1623 (Smith's *Gen. Hist.*, 171).*

Among Johnson's additions to Gerarde's Herball, 1636, there

* L'Ecluse (Clusius) heard of these *Macocks* in 1591, or earlier. In his *Exotica* (1605; lib. iii, c. 2) he describes a fruit—"*Macocqwer* Virginiansium, *forte*"—which had been sent him from London by James Garet, brought from "the province of Wingandecaow, which the English call Virginia." He *conjectured* that this might be "the fruit which the natives of that region call *Macocqwer*"—but his figure and description do not favor this identification. The fruit, he says, is nearly orbicular; four inches in diameter; with a hard rind, yellowish on the outside; many seeds, flat and heart-shaped ("cordis, ut vulgo pingitur, formam referentia"). L'Ecluse thought it might be one of the gourds which the natives used for rattles, as the Brazilians used their *Tamaraca*, etc. His specimen was old and dried, the pulp blackened, the rind covered with a dark membrane, "per quam sparsæ quædam fibræ à pediculo ad summum." This must have been a fruit of *Crescentia cucurbitina*, a calabash, which is a native not only of West Indies, but also of Southern Florida.

is a description of "*Macocks Virginiani*, sive *Pepo Virginianus;* the Virginian Macock or Pompion" (pp. 919, 921). The description is dated, 1621, and signed by John Goodyer. The plant has "great broad shrivelled yellow flowers, like those of the common Pompion." The fruit, "somewhat round, not extending in length, but flat like a bowl, but not so big as an ordinary bowl, being seldom four inches broad and three inches long; of a blackish green color when it is ripe. The substance or eatable part, of a yellowish white color. . . . "Seeds like the common Pompion, but smaller." The "small round Indian Pompion," and "the cornered Indian Pompion"—the latter resembling our common "scolloped Squash" ("*Pepones lati*, Broad Melons or Pepons" of Lyte's Dodoens, p. 588) are described and figured in Johnson's Gerarde, p. 920.

Beverley's History of Virginia, 1705, p. 124, mentions the *Macocks*, "a sort of Melopepones, or lesser sort of Pompion or *Cashaw*," which he identifies with the "*Squash* or *Squonter Squash*" of New England. "The Indian name," he says, "is still retained by them." Professor Schele de Vere (of Virginia) states that it still "survives in its anglicized form of *Maycock*" (*Americanisms*, 1871; p. 60).

The *Cushaw* (*Ecushaw*, Hariot) is described by Beverly (Hist. of Virg., p. 124) as "a kind of Pumpion, of a blueish green color, streaked with white when they are fit for use. They are larger than the Pompions, and have a long narrow neck. . . . The *Cushaws* and Pompions they lay by, which will keep several months good, after they are gathered" (p. 152). Bartlett, *Dict. of Americanisms*, notes the name *Cushaw*, "sometimes spelled *Kershaw*," as "Western" for a pumpkin. Beverley's description makes it nearly certain that the variety so named was the (New England) winter "crook-neck" squash—which, five and twenty years ago, might have been seen hanging, by its necklace of flannel "list," in every New England's farmer's kitchen, from early harvest time till wanted for Thanksgiving or Christmas pumpkin-pies.

The Rev. Francis Higginson, who came to New England in 1629, wrote from Salem, a few weeks after his arrival: "Here are stores of *pompions*, cowcumbers, and other things of that nature *which I know not*" (*N. E. Plantation*, 1630); and, again, "We abound with . . . sundry sorts of fruits, as musk-melons, water-melons, *Indian pompions*, Indian pease, beans, and many other odd fruits that I cannot name" (Young's *Chron. of Mass.*, 265). William Wood, who was in New England from 1629 to 1633, says, of the Indians of Massachusetts: "In summer, when their corne is spent, *Isquoutersquashes* is their best bread, a fruit like a young Pumpion" *N. E. Prospect*, p. 76). Roger Williams, 1643, names these "*Askútasquash*, their vine apples,

which the English from them call *Squashes*, about the bignesse of apples, of several colours, a sweet, light, wholesome refreshing" (*Key to the Language of America*, 103). Again, Josselyn (1638–71, *N. E. Rarities*, 57) mentions these "*Squashes* . . . more truly, *Squontersquashes*, a kind of melon or rather gourd, *for they oftentimes degenerate into gourds;* some of these are green, some yellow, some longish like a gourd, others round like an apple, all of them pleasant food boiled and buttered, etc. But the best yellow *Squash*, called an *Apple Squash*, because like an apple, and about the bigness of a Pome-water, is the best kind: they are much eaten by the Indians and the English." But he distinguishes these from the "*Pompions* [of which] there be several kinds, *some proper to the country;* they are dryer than our English Pompions, and better tasted; *you may eat them green*" (p. 91). The last words (here italicized) give a nearly literal translation of the Algonkin-Indian name of Cucurbits,—in the dialect of New England, *asq*, plural *asquash*, 'green things,' or (to be eaten) 'immature.' Eliot, in his version of the Bible (1663) names three kind of *asquash: askoot-asquash*, [=*Askùtasquash* R. Williams, *Isquoutersquash-es* of Wood, *Squontersquash-es* of Josselyn, ut supra,] for "cucumbers;" *quonoo-asquash* "gourds" [literally, 'long *asquash*']; and *monaskoot-asquash* "melons."

"Squashes" were first known to the Dutch, by their Algonkin name. Van der Donck, after speaking of the pumpkins of New Netherland (1642–53) adds: "The natives have another species of this vegetable peculiar to themselves, called by our people *quaasiens*, a name *derived from the aborigines, as the plant was not known to us before our intercourse with them.* It is a delightful fruit, as well to the eye on account of its fine variety of colours, as to the mouth for its agreeable taste. . . . It is gathered early in summer, and when it is planted in the middle of April, the fruit is fit for eating by the first of June. They do not wait for it to ripen before making use of the fruit, but only until it has attained a certain size. They gather the squashes and immediately place them on the fire without any further trouble. . . . The natives makes great account of this vegetable." *Descript. of N. Netherlands*, 1656; *transl. in N. Y. Hist. Soc. Coll.*, 2 Ser., i, 186.

Thus far, we have cited, with one or two exceptions, *American* authorities. M. DeCandolle, after mentioning "the three forms of *Pepones* figured by Dodoens, edition of 1557, to which a fourth, *P. rotundus major* was added in the edition of 1616," and a figure of *P. oblongus*, in Lobel. *Icones*, 641, observes, that "the names given to these plants indicate a foreign origin; but, the authors can affirm nothing, in this regard; the less so, because the name *Indian* signifies, either, of *southern Asia* or of

America" (p. 204). A collation of the descriptions of "Pepones" or "Cucurbitæ," given by European botanists of the 16th century, does away with this ambiguity.

Tragus (Hieron. Bock) *De Stirpium Nomenclaturis*, etc., 1552, p. 830, described and figured "*Melo, Pepo, Cucumis*, and *Citreolus;*" and (p. 832) named, also, *Cucumis sylvestris.* In the next chapter (p. 834) he wrote "De *Cucumere* seu, ut vulgo loquuntur, *Zucco marino*"—with a figure. "Many kinds of strange plants," he says, "have been brought from remote parts, into Germany, in the last few years." Among others, these "*poma æstiva*," of which some are large, some small, some round, some oblong, some sweet, others bitter, of various colors. "Some call these *Cucumeri*, and assert that they are *Turkish Cucumeres*, with which opinion I cannot agree. . . . I call them *Mala æstiva & Indica*," of which he distinguishes four kinds, *M. Indica crocea, lutea, citrina*, and *nigra.* "Commonly," he says, "they are called *Zucco marina*, because they first came to us from parts beyond the sea, some from Syria, some from *India*, which the names given them attest; for they are commonly called, *Zucco de Syria* and *Zucco de Peru.*"

The figure of "*Cucumer marinus*, Ital. *Cocomere marino*," etc., in the *Effigies Plantarum* of Fuchs, 1549, is a reduced copy of Bock's, and substantially agrees with that of *Pepo rotundus* in Lyte's Dodoens, p. 587, which was "called, also *Cucumis marinus;* of some, *Zucco marino;* in French *Concombre marin, Pompons Turquins*," etc.

Matthioli, of Padua (*Comm. in Dioscor.*, ed. 1559, p. 292) is more explicit. "There are," he says, "various kinds of cucurbits foreign to Italy, which can be kept fresh far into the winter. They say that these came into Italy *from the West Indies*, whence they are called by many *Indian.* Their taste is sweetish, not so insipid as ours," etc.; and his figure of "*Cucurbita Indica*" agrees with that of Bock's *Zucco marinus* (or "Zucco de Peru") and with Lyte's *Pepo rotundus.*

It is certain, then, that the botanists of the 16th century to whom M. DeCandolle refers, used *Indian*—when applied to varieties of *Cucurbita*—in the sense of *American.* In the 17th century, the evidence is not less direct. Parkinson (*Theatrum Botanicum*, 1640, pp. 769, 770) figures and describes (1) "*Cucurbita lagenaria major*, the greater Bottle Gourd;" (2) "*C. longa*, the long Gourd;" (3, 4) "*C. clypeiformis & verrucosa*, and *Anguria Aegyptiaca*, the Simmel [Scallop Squash], and the rugged Gourd [warted Squash, orbiculate depressed], and the Egyptian Citruell or Watery Million;" (5) *Cucurbita Indica, ovalis, pyriformis, & fere rotundus, Indian Gourds*, oval, pear fashioned, and almost round." Of these "Indian Gourds," he says: "There is very great variety of these Gourds (or *Millions*, as

some call them, or *Pompions*, as I may call them) that *came out of America or the West Indies*, from sundry places, both farther south among the Spanish colonies, and nearer hand, in our own of *Virginia*, *New England*, etc." He notes the great variety of size, shape and color, "some as great as our pompions, some as small as an apple, some discolored on the outside, green with whitish or yellowish stripes, . . some also reddish, spotted or striped, and some of a deep yellow."

Piso and Marcgrav (*Hist. nat. Brasilæ*, 1648, p. 44) describe and figure a plant called *Iurumu* [= *Yurumu*] by the Brazilians, and by the Portuguese, *Bobora*. M. DeCandolle, p. 201, is inclined to agree with modern botanists in referring this to *C. maxima;* but, as he remarks, it appears to have been a *cultivated* plant. If introduced from abroad, the name given it by the Tupis was probably formed, by prefix or affix, from that of some native (or naturalized) species to which it had some resemblance. In Montoya's *Tesoro*, 1639, we find *Yuruá* "calabaçillos silvestres," small *wild* calabazas: but the name *Yurumu* did not yet appear. Almost a century before the visit of Piso and Marcgrav, Jean de Lery saw in Brazil (1557) "certains *citrouilles rondes*, fort douce à manger," called by the natives *Maurongaus* (*Voyage*, ed. 1578, p. 217). The Tupi name *morangá* (the first two vowels nasal) denotes a 'handsome fruit.'

SCIENTIFIC INTELLIGENCE.

I. Chemistry and Physics.

1. *On the Change of Volume produced by mixing Solutions of Salts.*—Some experiments have been made by Nicol to extend our knowledge of the volume alterations attending the mixture of salt solutions. The solutions employed were molecular ones, consisting of from one to several molecules of salt dissolved in 100 molecules of water. After their specific gravities had been determined, ten times this specific gravity in grams was weighed out, thus giving equal volumes, which were then mixed together. Three distinct classes of salts were employed: (1) those containing the same metal or salt-radical; hence no double decomposition is possible; (2) those containing different metals and salt-radicals and in which double decomposition is possible; and (3) those which may unite to produce double salts. On mixing solutions of KCl and of NaCl of various strengths and in various proportions, contraction took place in amount varying from 3·4 to 99 volumes in 100,000. Diluting these solutions with an equal volume of water, gave a contraction for NaCl of 15·8 volumes; for KCl of 12·0 volumes; of 5NaCl (in 100 molecules of water) a contraction of 144·5; and of 5KCl one of 135·0. The difference in contraction on dilution between NaCl and KCl is 3·8; and between

5NaCl and 5KCl, 9·5; while the contraction on mixing the two was 3·4 and 9·8 respectively. Moreover, the contraction observed on mixing salt solutions of different strengths, is the difference between the contraction produced by the dilution of the strong one down to the mean strength C, and the expansion due to the concentration of the weak solution up to the mean, E; C−E= observed contraction. Hence $C_{Na} - E_{Na} = 99$, and $C_K - E_K = 87$, the sum being 186; while $C_{Na} - E_K = 92$ and $C_K - E_{Na} = 96$, the sum being 188 or practically the same. Where double decomposition is possible, as when 5NaCl and $5KNO_3$ or 5KCl and $5NaNO_3$ are mixed, the contraction was −1 at 20° and +7 at 40° in the first case and 29 and 38 in the second; showing that double decomposition has taken place in the latter, since the differences between the results at the two temperatures are practically the same. The result proves unsatisfactory where the formation of double salts is possible, since a change in water of crystallization takes place which produces unknown volume changes. The author therefore concludes: (1) When two salt-solutions, which cannot experience double decomposition, are mixed, a change of volume takes place due to the different affinities of the salts for water. (2) That double decomposition takes place in solution and that the volume change is an index and even a measure of this.—*J. Chem. Soc.*, xliii, 135, March, 1883. G. F. B.

2. *On the Mutual Displacement of Bases in solutions of their Neutral salts.*—In some experiments on the volumetric estimation of the organic bases, MENSCHUTKIN has observed some interesting facts on the mutual displacement of bases from their neutral salts. Aniline, as is well known, shows no alkaline reaction, either in aqueous or alcoholic solutions, when tested with a drop either of solution of rosolic acid or of phenol-phthalein; its salts react acid. If, therefore, an alkali solution be added to the solution of an aniline salt in presence of either of these indicators, no coloration appears; showing that the aniline is set free and a salt of the alkali formed. Finally a point is reached at which a single drop of the alkali develops the color. The aniline salts used were the hydrochlorate, nitrate and acetate. The bases were potassium, sodium, barium and ammonium hydrates, and triethylamine. By means of volumetric solutions of these bases, the amount of acid taken from the aniline was determined and in every case the whole was removed. This complete displacement of aniline by other bases is in entire accordance with Berthelot's principle of maximum work, the heat of combination between these bases and hydrochloric acid being as follows: KHO 13·7 calories; NaHO, 13·7; $(BaH_2O_2)_{½}$ 13·8; NH_3 12·3; $(CH_3)_3N$ 8·7; C_6H_5, H_2N 7·4. Hence the theory of Berthollet, that a division of bases takes place under these conditions, is not sustained by these experiments, stronger bases displacing totally the weaker. Nor does Berthollet's theory of mass find any support here. In a second series of experiments, Menschutkin used twice the quantity of aniline salt with the same result. Moreover the reactions took

place equally well in alcoholic solution. Since the heat of combination of triethylamine is next above that of aniline, experiments were next tried on its displacement. But since an aqueous solution of triethylamine shows a decided alkaline reaction, it became necessary to use alcohol as the solvent. The salts used were the hydrochlorate and the acetate. When titered with the normal alcoholic solution of alkali, numbers were obtained which showed the complete displacement of the triethylamine by the alkali; thus again disproving the law of Berthollet. Even ammonia itself shows the same result; solutions of bromide, nitrate and acetate, in alcohol, when titered with alkali solution, showed complete displacement. In titering back, the first drop of hydrochloric acid destroys completely the color of the solution; hence even in presence of a large excess of free ammonia, the acid unites exclusively with the fixed alkali, contrary to the hypothesis of Berthollet. Besides the importance of these facts in chemical theory, the author has founded upon them a quantitative method for the volumetric estimation of the organic bases referred to.—*Ber. Berl. Chem. Ges.*, xvi, 315, February, 1883. G. F. B.

3. *On the formation of Arsenides by Pressure.*—SPRING has continued his experiments on the formation of chemical compounds by simple pressure and now gives the results obtained with arsenic. When zinc filings and pulverized arsenic, mixed in the proportions required by the formula Zn_3As_2, are submitted to a pressure of 6,500 atmospheres, a homogeneous metallic-like block is obtained, crystalline under the microscope and brittle under the hammer. It dissolves completely in sulphuric acid, evolving hydrogen arsenide and leaving only a small black residue. A similar mixture of lead and arsenic gives a homogeneous block of a metallic luster, hard and brittle and which does not clog the file. The arsenide of tin corresponding to the formula Sn_3As_4, thus obtained, is a white metallic mass, brittle with foliated structure, fusible at a higher temperature than tin and difficultly soluble in hydrochloric acid with evolution of H_3As. The cadmium arsenide required three pressings, and gave a brittle metallic mass. No compound of as high a composition in arsenic, Cd_3As_2, could be formed by fusion. Copper combines with arsenic under pressure only with difficulty. After eight pressings a homogeneous metallic mass resulted, brittle and granular, grayish-white in color. Silver acts similarly, giving a bluish-gray homogeneous metallic mass. Arsenic itself, when submitted to 6,500 atmospheres, acquired a metallic luster and a specific gravity of 4·91. —*Ber. Berl. Chem. Ges.*, xvi, 324, February, 1881. G. F. B.

4. *On the Atomic Weight of Yttrium and Lanthanum.*—In 1872 CLÈVE determined the atomic weight of yttrium to be 89·485, the pure earth having been obtained by the partial decomposition of the nitrates and tested by the spectroscope, in which it showed no absorption bands. But since that time terbium has been discovered, or at least established, and Clève has now reëxamined the question. The yttria was purified by repeated partial precip-

itations of the solution of its nitrate by means of oxalic acid, the molecular weight being determined in each fraction. When this became constant, four fractions were obtained, each of which was converted into sulphate and yielded sensibly the same quantity of yttria, 48·507, 48·526, 48·497, 48·494 per cent. As a mean of twelve analyses made on different fractions, the number 48·503 ±0·0029 was obtained as the percentage of yttria in the sulphate. Taking O as 15·9633±·0035 and S as 31·984±0·012, the atomic weight of yttrium is 88·9±0·027. If SO_3 be taken as 80, the atomic weight is 89·02; or in round numbers 89.

Clève has also redetermined the atomic weight of lanthanum. The value which he obtained in 1874 was in round numbers 139. Brauner having more recently obtained 138·28, he was led to repeat his experiments on a purer product. Having about 1·5 kilograms of the mixed oxides, he converted them into nitrates, heated these up to partial decomposition, and dissolved in water; thus removing entirely the cerium and thorium. The solution was precipitated with very dilute ammonia in cold solution. The liquid soon becomes opalescent and lets fall an abundant deposit of basic salt. Seven different fractions were thus obtained, the last of which weighed 150 grams and consisted of lanthanum nearly pure. Its solution though colorless still showed the didymium bands. It was converted into sulphate, and fractionally crystallized. The last products showed no trace of the didymium spectrum and contained 15 grams oxide. Five products of recrystallization were obtained from this, as sulphates. These gave twelve atomic weight determinations, the minimum being 138·07 and the maximum 138·35. Taking the strictly accurate values of O and S, the atomic weight as a mean is 138·019±0·0246. Taking SO_3 as 80, the value is 138·22; confirming Brauner's results. Clève explains his former value by the great difficulty of driving off all the sulphuric acid in the ignition without producing a trace of dissociation.—*Bull. Soc. Ch.*, II, xxxix, 120, 151, February, 1883. G. F. B.

5. *On the Synthesis of Cryptidine.*—Among the bases obtained from coal tar, Williams found cryptidine, $C_{11}H_{11}N$. Leeds has succeeded in obtaining it artificially. When xylidine-acrolein is submitted to dry distillation, oily drops are obtained having a peculiar odor. About 155 grams of this substance, submitted in fractions of 20 grams, gave a distillate consisting of oily drops mixed with water, having an alkaline reaction. A porous coal remained in the retort. After removal of the water, the oil dried at 100° weighed 11 grams. It was converted into the hydrochlorate, repeatedly crystallized and then decomposed with potassium hydrate. The oil was collected, washed and again dried at 100°. It boiled constantly at 270°, had a reddish color and disagreeable odor. On analysis it gave numbers corresponding to the cryptidine formula. The hydrochlorate crystallizes in fine, thin colorless tabular crystals which sublime on careful heating. The platino-chloride falls in fine yellow needles when $PtCl_4$ in excess is

added to its solution. It is easily soluble in both water and alcohol.—*Ber. Berl. Chem. Ges.*, xvi, 289, February, 1883. G. F. B.

6. *A Text-book on the Elements of Physics*, for High Schools and Academies; by ALFRED P. GAGE, A.M. 414 pp. 8vo. Boston, 1883. (Ginn, Heath & Co.)—This will be found to be, in all essential respects, a very satisfactory book for the use for which it is intended. It presents the fundamental principles of the science with great clearness from the experimental side, and throughout in accordance with modern ideas; it contains much that is fresh in the subject matter, and the illustrations are new and good; in these respects it is a gratifying contrast to some of the more pretentious older text-books.

II. GEOLOGY AND MINERALOGY.

1. *Annual Report of the State Geologist of New Jersey, for* 1882. 192 pp. 8vo.—In the account of "geological work in progress" this Report, by Professor G. H. COOK, treats of the Red sandstone or so-called Triassic formation, the eruptive rocks of Sussex County Iron Mines, Plastic Clays, and Shore Changes. With regard to the Red sandstone it states that the conglomerates are confined mainly to the northwest border, but occur also in the central portion (p. 18), and on the southeastern border (p. 33), and they are calcareous, quartzose and granitic. The sandstone is usually seven-eighths or more of quartz, but contains feldspar, which is often unaltered, and in some cases much feldspar. A long table of strikes and dips is given, in which the directions are all west of north, and mostly between 20° and 50° west. The dips are stated to be in general toward the major axis of a large ellipsoidal area; and the sinking of such an area faster at the center than at the circumference, would, it is said, tend to fracture the strata and so make fissures for the escape of the trap.

In view of the general westerly dip of the beds in the New Jersey area and the easterly in that of the Connecticut valley, and a similar case between an eastern and a western area in North Carolina, Professor Cook expresses his inclination to adopt the hypothesis that "the various areas of the Red sandstone formation east of the Appalachians, from Massachusetts to South Carolina, were once in some way connected, and perhaps also those farther northeast in the British Provinces"; and that this great region of the rocks was afterward broken up into the actual areas by disturbance along "a number of axes of elevation, or else of great faults." As the point is one of much importance in American geology, the writer gives here some facts bearing on it from his own observations, which may be taken as supplementary to the general considerations presented by him in volume xvii, (p. 328), referring to a somewhat similar view.

The subject is in fact *The Origin of the Jura-trias of Eastern North America.*

(1.) The great area, a thousand miles long, if extending from Nova Scotia to South Carolina, covering various regions that

are now a thousand feet or more above the sea-level, must be assumed to have been either under marine waters, or else under the fresh-waters of an immense lake. The deposits, as all admit, are not marine; and too, they are not lacustrine. Those of the Connecticut valley correspond well, in all parts, to those of fluvial and estuary origin; and the others are not widely different.

(2.) The coarse and fine material of the deposits, as first observed by Professor Edward Hitchcock and since by all writers on the subject, came from the rocks bordering the existing areas, and are such as tributaries would have brought in. If the waters spread far outside of their present limits into a great lake, this would not have been true, for these rocks would have been submerged, and could not have contributed much, if any, to the sediments.

(3.) The beds bear evidence of swift currents and slow intermittedly, and often locally distributed, in the varying coarseness and fineness of the beds, answering precisely to the characters of the later valley deposits of the Connecticut; and these are fluvial, not lacustrine, conditions.

(4.) The coarse deposits are most common along or toward the borders of the area, yet are not excluded from other parts, and occur at intervals, not continuously, on these borders. The finer deposits prevail most over the middle portions, but occur also on the borders. The distribution corresponds with the distribution in the modern Connecticut valley—the result of deposition by a great river, and of coarse contributions here and there, especially along the borders, of the valley deposits, by tributaries.

(5.) The materials are the disintegrated crystalline rocks of the country, unassorted by beach action. Feldspar is present as well as quartz, and is generally abundant, and in as fresh a condition as in the neighboring gneiss or granite. It looks as if disintegration had gone on for a long age over the adjoining hills of metamorphic rocks, until loosened materials, scores perhaps hundreds of feet in depth, were made ready for the transporting waters. Disintegration by the rusting of the mica (biotite) is now making, to the east of New Haven, just such granitic sand as constitutes the coarse sandstone of East Haven.

(6.) Some of the more clayey beds contain small nodules and cylinders of limestone which are possibly of concretionary origin, like the common "clay-stones" of clay beds.

(7.) The coarseness of much of the sandstone, the unusual coarseness of the conglomerates in many places, especially on portions of the eastern border, the frequent occurrence of the flow-and-plunge structure in the sandstone, and the general irregular arrangement of the beds, all testify to Connecticut River floods, *much like the flood from the melting glacier*, during part of the era, or else to a succession of such floods.

(8.) Stones six inches to a foot or more in diameter, and small collections of large stones and gravel, often lie *isolated* in the sandstone, and prove that there were not only great floods, but

also ice-floes; for water alone could not make such local droppings among the fine deposits.

The characteristics are, in fact, quite closely those of the *stratified drift* of the valley. The abundant mica and the occasional pebbles of mica schist in the Portland beds (east of Middletown, Ct.) were evidently brought in by a stream from the northeast that flowed over the Bolton region of mica schist. The great and thick conglomerate of Montague and Sunderland, Massachusetts, wonderful for its coarseness, its stones being generally between six inches and three feet in diameter, extending from the junction of Miller's River and the Connecticut, southward, for eight to ten miles and there stopping, has its parallel in coarseness and in imperfect stratification in the remarkable stratified drift about the mouth of Miller's River, and tells as decisively of immense floods entering here the Connecticut valley; and judging from the greater extent of the Triassic deposit, they must have been vaster floods, or else longer continued, than those from the melting glacier. And "occasional masses three or four feet in diameter" (E. Hitchcock) make certain the presence of ice-floes.

So great ice-carrying floods seem to demand for their origin a glaciated condition for the Monadnock region and the White Mountains and other elevations of New Hampshire and New England.

Thus the facts seem to show that the era of the Red sandstone was one of great precipitation, with one or more long intervals of excessive cold. And the character and limits of the deposits are well explained on the view that a large estuary opened up from the Sound to the northern boundary of Massachusetts. This view requires no great movement in the land at variance with the older directions of movements, as would have been necessary for the connection of the Nova Scotia and Connecticut valley area; it merely requires, as the writer long since suggested, that the submerged coast plateau, eighty miles or so wide, off eastern North America, should have been at or near the sea-level. As he has pointed out, the Hudson River *under-sea* channel, crossing this plateau to its outer margin, is probable evidence that this condition formerly existed; it may have existed then (and many times besides) in American geological history.

It is a strong argument, I think, against the supposed cross connection of the areas that they all have a direction parallel to the earlier lines of uplift. The area passing through Pennsylvania has quite precisely the sigmoid form which characterizes fundamentally the courses of uplifts and general topography of the State. The Connecticut and New Jersey lines are in independent valleys, and had their independent origin; and in the Triassic, great movements went on that affected each fundamentally and not the intermediate region, for the valleys were alike in undergoing a gradual and profound subsidence during the period of the deposition of the sandstone, many of the beds bear-

ing evidence of shallow-water origin. An artesian boring at New Haven, now in progress by the Winchester Arms Company, has gone down into the sandstone 1500 feet *below the sea-level* without reaching the bottom of the formation; and, only two miles west, the metamorphic schists rise to a height of nearly 400 feet above the sea. The trough is here, consequently, over 1900 feet deep, and the pitch into it on this western side is at the rate of about 1000 feet a mile; and it may prove to be much greater when the artesian boring has gone down its next proposed 1000 feet. The maximum depth along the center of the trough may greatly exceed the depth near New Haven, whatever the amount. The valley in its independent movements, and its relations to the mountain-making disturbances of older time has nothing to favor the idea of any connection with that of New Jersey in the Triassic era, unless possibly through Long Island Sound; and this, if a fact, would not be of the kind implied in Professor Cook's hypothesis. J. D. D.

2. *Life of Sir William E. Logan*, Kt., LL.D., F.R.S., F.G.S., etc., First Director of the Geological Survey of Canada, by BERNARD J. HARRINGTON, Ph.D., Professor of Mining in McGill University, late Chemist and Mineralogist to the Geological Survey of Canada. 432 pp. 8vo, with steel portrait and numerous wood-cuts. Montreal, 1883. (Dawson Brothers.)—It was well for American geology that Sir William Logan was made Director of the Geological Survey of Canada. A man of patient, thorough, thoughtful research, of great precision in all his labors, sure in his steps of progress as far as this was possible in a region of so great complexities, and cautious in expressing his views, he was admirably fitted for work at the foundations of the science in America; and his results have proved to have the best of qualities; they stand, and American Geological Science is being built upon them. The "Azoic rocks" had been previously recognized; but Logan was the first to make known the structure, system of flexures, thickness, and other characteristics of the long series of schistose rocks, and trace out and map the folded strata of limestone they include, so as to give intelligible shape to these bottom terranes of the geological series.

The Green Mountains, and the country subordinate to them on the west with the included Taconic range, had previously been the subject of partial investigation and much speculation. But Logan found a starting point for new investigations in his Canadian discoveries, and thence worked, with his usual care, southward, over this field of metamorphic rocks to the Highlands of Putnam County, tracing the positions and relations of the various upturned beds; and he ended in establishing, in his view, the Lower Silurian age of the main system of beds, the Taconic group included, and their unconformability to the Highland Archæan. The fossils of the Canada starting point were of the so-called Quebec Group, which he described in 1863 (Rep., p. 233), after the study of the fossils by Billings, as "a great development of

strata about the horizon of the Chazy and Calciferous formations;" and he referred the various beds of the Green Mountains and Taconic region to this particular group. Subsequent discoveries of fossils in Vermont, and elsewhere, have determined that other parts of the Lower Silurian are represented, from the Primordial to the Trenton and Hudson River group inclusive; but they only modify and extend his general result. He found the limestones, the associated metamorphic schists, and the quartzyte (Sillery sandstones) *conformable* in Canada and along the Green Mountains; and the writer of this notice has observed the conformability *in superposition* between the quartzyte and the same associated formations in many sections through the States of Vermont, Massachusetts and Connecticut,—so thoroughly sustaining Logan's sections, that any apparent exceptions found since in Canada are necessarily of only local importance. As in Canada, so to the south, the quartzyte often *overlies* (sometimes nearly horizontally) the limestone and schists; but whether so through overturns or not is unsettled.*

In the course of the writer's explorations of Berkshire (Massachusetts) he was told, when at one of the hotels, of an unknown man of gray hairs stopping there for a while some years before, who was off on foot each morning after an early breakfast, hammer in hand, and returned, laden with specimens, at dusk: it was Logan in 1866, studying the question as to the relations of the limestones and the associated rocks.

The large, colored, Geological Chart of Canada prepared under Logan's direction, embodying the results of his survey and also—through the aid especially of Professor James Hall—the distribution of the geological formations over the Northern United States down to Central Pennsylvania, is another great work by Logan, of vast service to the geological science of the country. It is the only American geological map yet published that in exactness and fullness of detail and style of execution compares favorably with the best charts of the countries of Europe.

Dr. Harrington's biography of the able geologist gives a highly interesting sketch of his early life; his scientific studies and discoveries in England; his appointment "on recommendation of De la Beche, Murchison, Sedgwick and Buckland" to the position of Director of the Geological Survey of Canada; his various explorations, and the methods and results of his survey; his artistic sketching in his note-book; and a delighting exhibition of the man among men as well as at his work. An appendix contains a valuable article on the Quebec Group by Principal Dawson, and a list of Sir William Logan's more important publications. J. D. D.

3. *On the Utility of the Method of the Pennsylvania State Geological Survey in the Anthracite Field.* Extracts from a paper by Benj. Smith Lyman (late Geologist of Japan), read before the American Institute of Mining Engineers in February.

* The writer has in progress an investigation bearing on this point.

The Atlas* of the Panther Creek basin, in thirteen sheets (of 32 inches by 26), the first published result of the State Geological Survey of the Anthracite Fields of Pennsylvania, by Mr. Chas. A. Ashburner, Geologist-in-charge,† and several assistants, under the State Geologist, Professor J. P. Lesley, deserves attention from its great beauty, its high scientific value, the novelty of its methods of illustration, and the vast amount of practical instruction conveyed.

What is chiefly wanted from such a survey is of course direct or indirect aid toward turning to man's benefit the resources of nature, and in this case toward facilitating the mining of anthracite. Evidently nothing can help in that way more than a clear, trustworthy indication of the precise position, and the amount, of each workable bed of the coal, an answer to the questions: How much coal is there? where is it? at what depth? with how steep a dip? in what direction? with what basins and saddles of what length, breadth, depth or height? in what direction would level drifts run? where would the coal be best attacked by shafts or drifts? what beds of rock or coal lie above or below the coal worked, and at what distance? what is the situation of the coal with reference to water courses or other features on the surface of the ground? and the like; and it is easily conceivable that it would be impossible to give indications of this kind so fully and satisfactorily with a whole volume of words merely, as with a properly constructed map. Thirty years ago, Professor Lesley devised and brought into use a method of representing such geological facts, by a topographical map, with contour lines, and with the outcrop of certain beds and the course of a single level upon them, say the lowest water level of a tract.‡ But three of the present sheets are drawn in a somewhat improved way, showing more thoroughly the whole position and detailed structural shape of a coal bed by numerous curved lines equidistant in level, like the contour lines of surface topography. The result is a complete and satisfactory geometrical construction of the bed upon paper, leaving nothing further to hope for in precision and clearness and compactness of working information. The method has never before been applied to so large a field, with such completeness in minute details.

* The State price of this atlas is $1.50, and it can be obtained either in rolled sheets in a pasteboard tube or folded sheets in an octavo pocket, by addressing F. W. Forman, Clerk of Survey Commission, 223 Market Street, Harrisburg.

† Mr. Ashburner was placed in charge of the Anthracite Survey in August, 1880, when a reconnaissance of the coal fields was commenced. In the following November a plan was submitted to Professor Lesley for mapping the coal basins. This plan was adopted by the Board of Commissioners, and was briefly described by Mr. Ashburner before the American Institute of Mining Engineers, February, 1881 (Trans. vol. ix, p. 506). On account of a failure in the Survey appropriations the Anthracite Survey was not regularly organized until July, 1881, since which time the work has been vigorously pushed forward. On the first of last January the field work in one third of the region had been completed. It will probably take four or five years to complete the survey.

‡ Mr. Lyman has used this method of representing geological structure on his Japanese maps, but not in so precise a way as is done by Mr. Ashburner.

The general facts disclosed about the shape of rock-beds are novel even to experienced geologists. It is here seen that beds of coal and other rocks are folded together with much less uniformity of shape than had hitherto been supposed, as irregularly in fact as a carpet crumpled together by a push from one side. Another feature noticeable is the absence of faults in a region that has been very much disturbed and has some overturned dips.

With such maps as these it can be seen where drainage adits or other levels may be driven; where and at what depth shafts will strike a given coal bed; what portions of a mine underlie buildings on the surface; in short all the principal geological requirements for working a mine are plainly set forth; and money need not be wasted (as many hundreds of thousands of dollars have been) in groping blindly for a coal bed, with digging according to the necessarily inaccurate guesses or opinions of even the clearest-headed or most confident miner.

In addition to the extremely valuable and elaborate underground map of the surface of the Mammoth Bed, on a scale of 800 feet to an inch, there are three sheets of twelve cross sections of the basin at different points, on a scale of 400 feet to an inch, showing the several coal beds in their relative position and distance apart wherever positively known, together with twelve cross sections at the same points on one-fourth the scale, to show the connected structure of the Mammoth coal bed, whether actually seen throughout or not; and a small skeleton map of the basin (3200 feet to the inch) to show the places of the sections. All these sections across the basin are on the same scale vertically as horizontally, and hence show the geological structure undistorted, which is of course their true object.

But on such cross sections of the structure the scale has to be too small to give many details of the thickness and composition of the beds of coal and rock; and moreover the full sequence of beds cannot be seen at any one point. On two other sheets, therefore, the coal beds are drawn on a much larger scale, forty feet to an inch, in seventeen columnar sections at different parts of the basin, showing the true relative order, thickness and distance apart, of all the important beds, whether of coal or of rock of different kinds. On the same sheets are added five similar columnar sections, on a smaller scale (100 feet to the inch), of the Pottsville conglomerate underlying the set of workable coal beds; and besides, a diagram, on a scale but one-third as large, of twelve columnar sections of the Pennsylvania Geological Formation, No. XII, and up to the Mammoth Coal Bed; also a convenient repetition of the little skeleton map to show the places of the sections. Such sections of course, if compared with what is found in a shaft or boring or in natural exposures, show how vain it would be to dig for workable coal at many a point where perhaps a small streak of coal or black slate, or dark colored earth, may (as so often has happened with consequent immense loss of money) create, for a time, illusory hopes of discovering a valuable coal mine.

The scale, however, of these columnar sections is too small to show certain features of a coal bed of great importance in working its different layers; and so there is a sheet with twenty-eight columnar sections of coal beds on a scale of ten feet to an inch; including that marvel, the Mammoth bed, at one point over 114 feet thick, with nearly 106 feet of coal and the rest several layers of slate. On the same sheet there is in addition a diagram (200 feet to the inch) of seventeen columnar sections, side by side, to show the true relation to each other of the coal beds known, and sometimes differently named, at different parts of the basin. Such identification of the beds of different mines is plainly of very great importance in giving a knowledge of what beds may be expected to be found above or below a bed that is actually worked; for an error in naming one bed may lead to enormous pecuniary losses from the mistaken views it may engender in regard to what is above or below.

Another sheet gives a topographical map of the surface on a scale of 1600 feet to an inch, half less in scale than the underground map, and with contour lines every ten feet.

To give a knowledge of the situation of the basin with reference to the whole anthracite region, a sheet is added with a general map of the northeastern corner of Pennsylvania, on a scale of nearly five miles to an inch, showing all the different fields in their relative position. On the same sheet there are eleven columnar sections, on a scale of 300 feet to an inch, to show the coal beds of the different basins and their relation to one another. It is striking here how variable is the number of coal beds in the different sections and at what variable distances apart. The sheet has further a list of the 340 collieries in operation, with their yield in 1881, amounting in all to thirty and one-half millions of tons.

The total annual yield of anthracite year by year from the beginning is given on a separate sheet, divided, too, in separate fields, and illustrated with a large diagram of pyramidal shape of the kind published for many years by Mr. P. W. Sheafer.

With such enormous drafts upon the fixed deposit of coal the very weighty question presses forward: how long before the whole amount will be exhausted? It is of course impossible to foresee what may be the future increase in the yearly demand; we can only judge more or less approximately by such tables and diagrams as these from what has taken place in the past. But with materials of the kind supplied by the present atlas we can ascertain how large the amount of coal is that we are drawing upon; for on the underground map the actual extent of the Mammoth Coal Bed and of its comparatively small portions hitherto worked out is given, and the columnar sections show by what thickness of coal the area of the bed is to be multiplied to find its amount. A separate sheet is given to the illustration of the method of calculating the complete area of the coal bed in spite of its inclination at different points and even of its overturned condition in

some places. The drawing shows both the horizontal extent of the bed as it now lies and the space it would take up if flattened out. The same sheet has tables of figures to show the extent of the different workable coal beds in the basin.

Every Pennsylvanian and American, directly or indirectly interested in the anthracite lands or mines, or in the price of anthracite, or iron, or other articles for which anthracite is largely consumed, must look with impatience and patriotic pride to the completion of a survey that has so practical and forcible a bearing upon the mining of so valuable a fuel. All interested in geology cannot fail to await with eagerness and great anticipations the rest of the Anthracite Survey's publications, begun by a work of so great value and of so superior plan and execution.

A good survey, however laborious it may be, costs but a trifle compared with the great sums that are often cheerfully spent by the ignorant for trials by digging that give nothing like completeness and definiteness of result. Even if the separate mine owners should carry out such surveys, each at his own expense (as it might be urged they ought to), the results would be far less satisfactory and valuable than can be obtained from a combination of the whole field, for the facts seen on one tract help greatly to elucidate those of another. Moreover the expense of such separate surveys would be much more, an expense that must ultimately be borne by the consumers of the coal. Furthermore, the expense of a combined, or State survey is infinitesimal compared with the value of the coal whose mining is facilitated and cheapened. The present Geological survey is in fact managed so economically that all the field and office work for the whole State costs each year less than one-sixth of a cent on every ton of anthracite yearly mined, and of this sixth the outlay for the anthracite survey is little over a third.

4. *Bulletin of the U. S. Geological Survey.* No. 1.—This first number of the Bulletin of the United States Geological Survey, contains the valuable paper by WHITMAN CROSS, on Hypersthene andesite and on triclinic pyroxene in augitic rocks (see an abstract in this Journal, xxv, 139), with a geological sketch of Buffalo Peaks, by S. F. Emmons, Geologist-in-charge of the Rocky Mountain Division.

5. *Palæontology of the Geological Survey of New York.* Vol. v, Part I. *Lamellibranchiata*, by JAMES HALL.—This quarto volume contains the plates of the Lamellibranchs of the Upper Helderberg, Hamilton and Chemung groups, eighty in number, all of which are well executed, along with explanations of the plates. No descriptions are given excepting brief characters of the new genera proposed. These plates were lithographed several years since, and 3,000 impressions, the usual number, were struck off by order of the State. The text has been ready for publication, but for more than three years no printing has been done on the Paleontology, the needed appropriation by the legislature not being made. Descriptions of the species will probably

appear in the publications of the State Museum in the course of the year, but all is uncertainty as to the appearance of the text of volume V. in the Paleontology. The delay works evil to geological science by impeding the work of others who need to use the results in the study of the fossils of other States, and by hindering the progress of the science in this and other countries.

6. *North American Fossil Mammals.*—In the March number of the American Naturalist, Professor Cope has an important paper on the Extinct Dogs of North America, with many illustrations; and in that for April, a continuation of his memoir on the Extinct Rodentia.

7. *Annelid Remains from the Silurian of the Isle of Gotland;* by G. J. HINDE. (Communicated to the Swedish Academy of Sciences, Sept., 1882.)—Mr. Hinde has continued his discoveries of Annelid remains from Canada and England to the Island of Gotland. The specimens described in this paper from the latter region are numerous, and their figures cover three plates. He observes that the nearest living representatives of these ancient Annelids are those in the family of the Eunicea, an opinion sustained by Professor Ehlers, the principal authority on living Annelids.

8. *A Review of the non-marine Fossil Mollusca;* by CHARLES A. WHITE. 144 pp. large 8vo. Extract from the Annual Report of the Director of the U. S. Geological Survey, 1881–1882, Washington, 1882.—This review is one of great geological importance. The subject is discussed as regards some of its points by Professor White in volumes xx and xxiii of this Journal (1880, 1882), but is here treated with fullness, and with reference to formations of all ages.

9. *Second Report of the State Mineralogist of California*, from December 1, 1880, to October 1, 1882. 288 pp. 8vo, with an Appendix of 226 pp. Sacramento, 1882.—This second Report by Mr. HENRY G. HANKS, State Mineralogist of California, contains a statement of the work accomplished by the Mining Bureau since December, 1880, in the collecting and arranging of a State Museum at San Francisco of the various mineral products of the State, and also in the analysis and determination of minerals, and otherwise in giving information as called for. The Report also contains several papers on general subjects, in which much useful information has been brought together. The first and most extended of these is devoted to the subject of placer mining. It describes the development of this kind of mining, and gives with much detail the successive steps involved, from the preparation of the storage reservoir to the final assaying of the gold extracted; numerous tables are added, giving facts in regard to the flow of water through pipes, through nozzles of different sizes, and other kindred points. This memoir also contains various other points of interest, as the size of the larger gold nuggets found, tables of the average yield of gold for different mines, and so on; it closes with a brief statement in regard to the pro-

duction of gold at foreign localities. Some of the other topics discussed in the report are: the iron ores and iron industries of California; lumber and fuel; the occurrence of salt and its manufacture; mud volcanoes and Colorado Desert; diamonds in California. The Appendix contains papers on the forest trees of California by A. Kellogg; notes on hydraulic mining by F. W. Robinson; on hydraulic and drift mining by Henry Degroot; on the milling of gold quartz by Melville Attwood; on rare minerals recently found in the State by W. P. Blake; on flour gold by A. B. Paul.

10. *Zur Kenntniss der vulcanischen Gesteine und Mineralien der Capverd'schen Inseln von* Professor Dr. C. DOELTER. 94 pp. Graz, 1882.—The author has published in another volume the results of his topographical and geological examination of the Cape Verde Islands. The present memoir is devoted to a detailed description of the various volcanic rocks collected and studied by him and of the accompanying minerals. As older eruptive rocks are recognized: foyaite, syenite, diorite and diabase; as younger eruptive rocks: leucitite (rare), phonolite, tephrite, basanite, plagioclase-basalt, nephelinite, nepheline-basalt, limburgite, pyroxenite. The author has applied the various modern methods to the examination of the different rocks, and his descriptions are hence unusually complete; he thus gives not only the constituent minerals and their composition in each case, but also the percentage amount in which they enter. The rock called *pyroxenite* is described as a limburgite, or magma-basalt, without olivine, in other words, a rock consisting essentially of augite, magnetite, and a glassy base, with, as an accessory, haüynite and rarely plagioclase, nephelite and olivine.

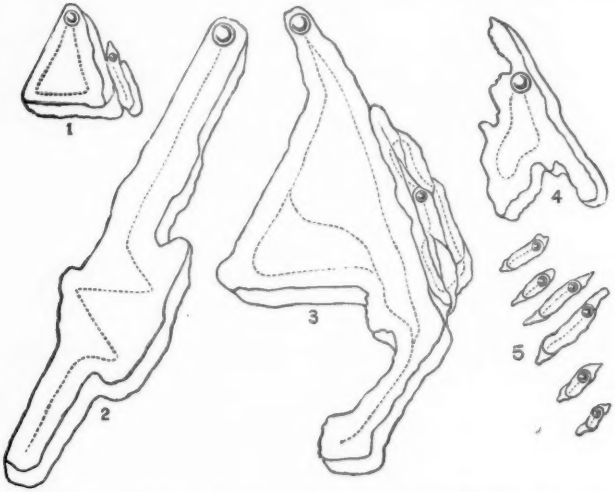
As a secondary mineral, occurring at several spots on the island of Santo Antonio, in crevices on the lava, the author describes a new member of the alum group, under the name of *Dumreicherite*. It forms crusts on the lava, with fibrous structure. An optical examination showed it to be probably monoclinic; this result was confirmed by a study of the form of the crystals obtained artificially from the solution of the mineral. It is easily soluble in water, taste astringent, fuses in the water of crystallization. An analysis by F. Kertscher gave:

SO_3	Al_2O_3	MgO	H_2O	
36·65	7·14	11·61	45·01	Na, Cl tr. = 100·41

The calculated formula is $4MgSO_4 + Al_2S_3O_{12} + 36$ aq.

11. *Fluid-bearing Quartz Crystals.*—Mr. W. E. HIDDEN has recently described a remarkable occurrence of quartz crystals containing fluid inclusions from Alexander County, North Carolina. A single pocket was found, seven feet long, and about three feet in width and depth, which afforded over four hundred pounds of choice quartz crystals, and including all grades, about half a ton. It was from this pocket that the remarkable emeralds previously described (see vol. xxii, 489) were obtained. The cavity was lined with red mud, and the quartz crystals, except at the bottom, had

become detached by process of disintegration and were imbedded in the mud. The crystals containing fluid cavities were of citrine-yellow to chocolate-brown color, transparent, and of high luster; they were implanted upon the crystals which had been directly attached to the walls. The cavities were of unusual size; the longest had a length of two and one half inches; others an inch in length were not uncommon, and those of smaller size were too numerous to be counted. The accompanying figure shows



some of the cavities of natural size; the fluid contained was water with also some liquid carbon dioxide. Unfortunately this remarkable collection of water-bearing crystals was left exposed to a temperature below the freezing point during a night in the late autumn; by the freezing of the enclosed water the crystals were shattered and reduced to fragments, which were in some cases frozen together to a coherent mass. The ice formed was believed to be due in part to the condensation of the moisture of the surrounding atmosphere by the cold produced by the sudden expansion of the carbon dioxide liberated.

III. Botany and Zoology.

1. *Essay on the Development of the Vegetable Kingdom, especially on the Distribution of Floras since the Tertiary period: Versuch einer Entwicklungsgeschichte der Pflanzenwelt, insbesondere der Florengebiete seit der Tertiärperiode;* von Dr. Adolph Engler, Ord. Professor an der Universität Kiel. 8vo. 1879, 1882. Leipzig, W. Engelmann.—This interesting treatise is in two parts, or volumes; the first, published in 1879, discussing the develop-

ment and distribution of the extra-tropical floras of the northern hemisphere; the second, issued in 1882, those of the southern hemisphere and the tropics: the whole in a little less than 600 pages, full index included. It is a more succinct work than its predecessor, *Der Vegetation der Erde nach ihrer klimatischen Anordnung*, of the late Prof. Grisebach, is conceived in a different manner and developed in a more modern spirit. It may rather be said to take up the lines where Alphonse de Candolle left them at the close of his *Geographie Botanique Raisonée*, in which he reached the conclusion—which the scientific world had then just come to—that the present character and distribution of the actual vegetable kingdom, though ruled by climatic and geographical conditions, was to be explained only by a consideration of the preceding vegetation, namely, that of the tertiary period. Beyond this general proposition, DeCandolle was then (in 1855) not able to go. The *Origin of Species* had not appeared. And as respects the northern hemisphere and its floras, where the key to the mystery was to be sought, Heer and Unger were reviving in this interest Plato's idea of the Atlantis. But the very next year, 1856, the first memoir of the present writer was published (Mem. Amer. Acad., vol. vi), and what Nathorst and Saporta unite in pronouncing "the true solution of the problem," was brought to light.*

From these lines and from the doctrine of natural selection proceed the "leading ideas" of Dr. Engler's work, formulated in thirty-six propositions in the introduction, and applied in the first volume to the elucidation of the distribution of the vegetation of the temperate part of the northern hemisphere. This part opens with a good sketch of the development of the North American flora, from the Miocene down to the Glacial period, treating first the Miocene of the arctic, then the distribution of North American forest during the Miocene, and its gradual transformation

* Ann. Sci. Nat., ser. 6, xv. 153.—Count Sarporta adds in a foot-note that "Asa Gray was not the only botanist who had the idea of explaining the presence of disjoined species and genera, dispersed across the boreal temperate zone and the two continents, by means of emigrations from the pole as the mother region, whence these vegetable races had radiated in one or several directions. This had been *paralellement* conceived and developed in France, upon the occasion of the remarkable works of Prof. O. Heer," etc.

The parallel memoirs there referred to are one by Count Saporta, published in 1872, and one in 1876 by the same author, in conjunction with Dr. Marion. The first of these appeared in the same year with "Sequoia and its History: an address of the retiring President of the American Association for the Advancement of Science," August, 1872: but the initial memoir, in Mem. Amer. Acad., vi, 1856, preceded the publication of Heer's researches upon the arctic Miocene flora, and had the advantage—or disadvantage—of developing the principal ideas from a consideration of the existing vegetation only,—not so well, indeed, as has since been done; but now that these views are completely adopted, it is perhaps worth while to reproduce these dates. The explanation (given in 1878) for the extinction of Tertiary elements of the flora in Europe, which have been preserved in North America and Asia, is recapitulated by Nathorst, as likewise by Wallace, in his Island Life (pp. 119 and 120), in the latter case without allusion to its source.

into the present vegetation and segregation into the present floral regions. The relations of this flora to that of N. E. Asia and to that of Europe are then very briefly illustrated; and farther on, after a consideration of the eastern and central Asiatic floras in the Tertiary and later, the exchange of floral elements between Asia and North America is well discussed. Some addition to the interest of these topics might have been drawn from the papers of 1872 and 1878, alluded to in the preceding foot-note, both of which were printed in this Journal (the former without the comparative lists given in the official edition), but they seem to have escaped Dr. Engler's attention.

Succeeding chapters treat of the European floras, ancient and modern; upon the development of the high mountain flora before, during, and since the Glacial; upon the more important migrations during the Glacial period; and upon the high mountain floras of North America, illustrated by some good lists, in which, however, alpine plants need to be discriminated from those which are no-wise alpine. Important, also, are the closing sections of the first volume, on the influence of the Glacial period upon the vegetation outside of the mountains, and on the localization of glacial plants. This volume has a colored chart showing the distribution of land and water in the northern hemisphere during the Miocene; the second volume, one illustrating the floral provinces, outlined in the last chapter of the work, as defined on the one hand by climatic features, on the other by their physiologically characteristic groups of plants, i. e., those whose adaptive characters in various ways fit them for the particular district, whether arid or moist, hot or cold, equable or extreme.

In a notice like this we naturally turn only to those parts of the work which most interest us. Our limited space and time preclude even an abstract of the contents of the second part of this work, which cannot be less interesting than the other, and apparently has more novelty of treatment. Our purpose is served by making known to American naturalists and students a volume which they will wish to possess and be sure to value,—the latest text-book upon the subject, and one well up to the time.

A. G.

2. *Bidrag till Japans Fossila Flora;* af A. G. Nathorst. (From "Vega-Expeditionens Vetensk. Arbeten," ii, pp. 121–225, tab. 4–19, 8vo, 1882.)—This paper, one of particular interest to us, should have had an earlier notice, and would naturally have received it from our veteran phytopaleontologist. After a wistful glance it had here been laid aside, awaiting the chance of a translator from the Swedish, and so forgotten, until the preceding note was written, by the opportune help of a French abstract published in Ann. Sci. Nat., tom. xv, 1883, by the Marquis Saporta. The fossil remains which form the basis of this memoir were mainly collected at a place called Mogi, not far from Nagasaki, and their special interest lies in the fact that they presumably represent the vegetation of the locality at a period "not more ancient than later

Pliocene, and not later than the middle of the Glacial epoch." Saporta has drawn up his catalogue of the remains under two heads, the first of fairly determinable plants, with generic and specific names, fifty-one in number. Among them he identifies a *Betula* near to our *B. lenta*, *Ostrya Virginica*, *Fagus ferruginea*, *Vitis Labrusca*, and a *Magnolia* allied to our *M. acuminata* or *cordata*. Among the indeterminable leaves are some resembling those of *Carya amara* and of *Quercus aquatica*. Of species identified with or nearly like living Japanese species, a *Zelkova*, two species of *Styrax*, *Deutzia scabra*, *Acer pictum*, *Dictamnus Fraxinella*, and *Stuartia monadelpha*, may be mentioned. The bearing of this evidence, as supplementary to that furnished by earlier deposits, upon the explanation of the intimate and peculiar relations existing between the actual North American and northeastern Asian floras, is obvious, and is well discussed by Nathorst in this paper, the *generalia* of which are now made accessible to us in the French abstract for which Saporta is to be heartily thanked. The thirteen plates of these fossil plants are in quarto.

Let us add our acknowledgments to the author for a copy of the elaborate and important memoir (in the Transactions of the Royal Academy of Sciences at Stockholm) by Nathorst, upon the tracks made by invertebrate animals, and other traces, which simulate Algæ, being the memoir which called out Saporta's paper, recently noticed in this Journal, p. 235. It is illustrated by numerous wood-cuts in the letter-press, and by eleven fine photographs in quarto, and, moreover, is made accessible by an appended translation into French, with some additions. A. G.

3. *Structural and Systematic Conchology.* By GEORGE W. TRYON, Jr., Vol. I, 8vo, 312 pp., 22 plates. Philadelphia, 1882.—This work is intended as a manual of Malacology. It is, as stated by the author, almost entirely a compilation, both as to text and figures. The principal sources from which it has been compiled are Woodward's Manual of the Mollusca, and Dr. Fischer's Manuel de Conchiliologie. Mr. Tryon's work is much inferior to Dr. Fischer's, both in matter and execution. The author has attempted to combine the antiquated ideas of classification that prevailed twenty-five years ago, with those that have been brought forward by the more accurate and elaborate investigations of modern malacologists. The result, as might have been expected, is heterogeneous and incongruous. Inasmuch as there is no good conchological manual in the English language more modern and comprehensive than Woodward's, which is now antiquated, it is to be regretted that Mr. Tryon's has not been executed with more care. Nevertheless, it will undoubtedly be found very useful by a large number of persons to whom the larger and more elaborate works are not accessible. The present volume includes chapters on anatomy, habits, geographical and geological distribution, nomenclature, classification, and collecting. V.

IV. Miscellaneous Scientific Intelligence.

1. *Report of the Superintendent of the United States Coast and Geodetic Survey for the year ending June*, 1880.—This report exhibits in a striking manner the extension of work expressed in the change of name of the Survey by the addition thereto of *Geodetic*. The carrying of the primary and secondary triangulation from the coast over the States has been prosecuted in earnest. This will be of the highest value to the States, since it will give them a uniform and connected frame-work for use in all local surveys. Incidentally to this is begun the measurement of the arc of the 39th parallel nearly 50° long, and of the 99th degree of longitude, which in the United States is 23° long, and which may be extended north and south to a length of 50°. This will furnish two lines of the highest value in solving the great problem of the figure of the earth. The western part of the 39th parallel is admirably situated for using long lines in the primary triangulation. One of those actually observed on is 192 miles long.

Among the appendices should be specially named: a report on the results of the Longitudes of the Coast and Geodetic Survey determined up to the present time by means of the electric telegraph, by Mr. Schott; a report on the blue clay of the Mississippi river, by Dr. Little; a treatise on the plane table, by Mr. Hergesheimer; on the determination of time, longitude, latitude and azimuth, by Mr. Schott; report on the currents and temperatures of Bering Sea and the adjacent waters, by Mr. Dall; and an attempt to solve the problem of the first landing place of Columbus in the new world, by Capt. G. V. Fox.

Mr. Schott gives in his four papers on the determination of time, longitude, latitude and azimuth a new edition of papers that had been previously issued, on the use of portable instruments in their various forms as employed in the Survey. To one statement in the third part (p. 245) exception ought to be taken. In speaking of the temporary conversion of the ordinary transit instrument into a zenith telescope by attaching to the former a delicate level and micrometer, Mr. Schott says that Mr. Davidson *first*, and Professor Lyman *subsequently*, made the suggestion and practical illustration of it. Not only this suggestion and its practical illustration, but also its publication by Professor Lyman, preceded those by Mr. Davidson. H. A. N.

2. *Telescopic Meteors.*—In the Observatory for April, Mr. Denning remarks upon the number of telescopic meteors observed in his ten-inch reflector while using comet eye-pieces. He says: "A rough computation from my own somewhat meager results shows that in a space of sky about 50° square (such as may be well commanded by the naked eye) the hourly number of telescopic meteors is about 260, whereas the number of naked-eye meteors averages 12, so that the proportion of telescopic to naked-eye meteors is as 22 to 1." He remarks on the apparent slow motion of the telescopic meteors. He makes the suggestion that observ-

ers engaged in comet sweeping keep a record of the number of telescopic meteors seen and the length of time of observation. Such a record would be of special value, and we trust it will be followed by persons using low-power telescopes.

The time, direction, length of path, velocity, brightness, etc., of such meteors, with diameter of field and magnifying power, would be desirable items in such a record. This would be particularly true for nights of special abundance, like the 10th of August. The area which Mr. Denning names as one that can be commanded by an observer is, we believe, much too great (this Journal, II, xli, 191). On the other hand, it is doubtful whether the whole field of a comet-seeker can be well commanded.

H. A. N.

3. *Gold Medal of the Royal Astronomical Society of London.*—The gold medal of the Astronomical Society has been awarded this year to Dr. B. A. Gould for his Uranometria Argentina.

4. *Medals awarded by the Geological Society of London.*—At the annual general meeting of the Geological Society, held February 16, 1883, the awards by the Council of the various medals were announced. The *Wollaston Gold Medal* was awarded to Mr. W. T. Blanford, "in recognition of services to geology in Abyssinia, in Persia, and on the Geological Survey of the Indian Empire." The balance of the proceeds of the Wollaston Donation Fund was awarded by the Council to Prof. John Milne, of Tokio, Japan, "to mark its appreciation of the importance of his investigations into the phenomena of earthquakes, to which he has devoted so much time and attention during his residence in Japan." The *Murchison Medal* was awarded to Prof. Heinrich Robert Göppert, of Breslau, "in recognition of his labors in fossil botany." The balance of the same fund was given to Mr. John Young, F.G.S., of the Hunterian Museum, Glasgow, "in appreciation of his long-continued researches on the fossil polyzoa, etc." The *Lyell Medal* was presented to Dr. W. B. Carpenter, "in recognition of the great value of his investigations into the minute structure of invertebrate fossils and his deep-sea researches." One-half of the balance of this fund was given to Mr. P. Herbert Carpenter, author of papers on Jurassic Crinoids, Cretaceous Comatulæ, etc.; and the other half to M. E. Rigaux, of Boulogne, author of researches on the Jurassic formations of the Boulonnais and their contained fossils. The *Bigsby Gold Medal* was presented to Dr. Henry Hicks, in "appreciation of his labors among the oldest fossiliferous and the Archæan rocks of Great Britain and Ireland."

5. *The Eastern United States Society of Naturalists.*—At a meeting held in the early part of April, at Springfield, Mass., there was organized "The Society of Naturalists of the Eastern United States," with the following officers: President, Professor A. Hyatt of the Massachusetts Institute of Technology; Vice-presidents, Professor H. Newell Martin of Johns Hopkins University and Professor A. S. Packard, Jr. of Brown; Secretary,

Professor Samuel F. Clarke of Williams; Treasurer, Professor William B. Scott of Princeton; these officers constituting the executive committee. The object of the society is "the association of working naturalists for the discussion of methods of investigation and instruction, laboratory technique and museum administration, and other topics of interest to investigators and teachers of natural history, and for the adoption of such measures as shall tend to the advancement and diffusion of the knowledge of natural history in the community." Membership is limited to instructors in natural history, officers of museums and other scientific institutions, and other persons professionally engaged in some branch of natural history. Meetings are to be held at different places designated by the society, not outside of the Eastern or Middle States, Maryland and the District of Columbia. The annual meeting is to commence on the second Wednesday of March in each year, unless otherwise ordered by the executive committee. Provision is made to encourage the formation and coöperation of similar societies in other parts of the country. The society starts off with a membership of 27, representing the leading institutions in its district, and at the opening meeting, fifteen additional names were proposed for membership.

6. *National Academy of Sciences.*—At the meeting of the National Academy at Washington in April, Professor O. C. MARSH, who, as Vice-President, had been the Acting-President since the decease of Professor WM. B. ROGERS, was elected to fill the office of President. The following persons were elected members of the Academy: A. Graham Bell, Dr. John S. Billings, Professor G. K. Gilbert, Professor H. B. Hill and Professor C. Loring Jackson; and the following Foreign Associates: Adams, Anvers, Berthelot, Bertrand, Boussingault, Calley, Chevreul, Clausius, DeCandolle, Dumas, Helmholtz, Hooker, Huxley, Kirchhoff, Kölliker, Oppolzer, Pasteur, Richthofen, Sylvester, Stokes, Struve, Thomson, Virchow, Wurtz.

On Thursday, the 19th, the Academy participated in the ceremonies connected with the unveiling of the statue of JOSEPH HENRY, under the auspices of the Smithsonian Institution, at which all the departments of the Government were represented. The oration on the occasion was delivered by President Noah Porter of Yale College, one of the Regents of the Smithsonian Institution, and was an admirable tribute to the memory of the eminent physicist. A list of the papers read at the meeting is deferred to another number.

7. *Index to the Popular Science Monthly* for the twenty volumes from 1872 to 1882, and of the three volumes of the supplement. 169 pp. 8vo. New York: 1883. (D. Appleton & Co.)—The publishers of the well-known Popular Science Monthly have done its readers an important service in issuing this convenient Index.

OMISSION.—*Contributions to the Geological Chemistry of Yellowstone National Park.* The analyses on page 351 are by H. LEFFMANN.